SCIENCE

VOL. LXVII MARCH 23, 1928 No. 1734

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal.
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

GEORGE SUMNER HUNTINGTON, ANATOMIST[1]

TO-NIGHT there are gathered here the colleagues and friends of the late George Sumner Huntington to do honor to him whom all of us admire and respect for his works, to whom many of us are held by the strongest and closest bonds. Posterity knows a man through his accomplishments; his personality lives only in the memory of those with whom during his lifetime he was intimately associated. It would seem appropriate that in this company I should dwell more on the man, on his great and compelling personality, than was possible in the address that I recently delivered before the American Association of Anatomists.

My own acquaintance with Huntington dates back to 1890 when I was a student of his in the College of Physicians and Surgeons. It was not until the autumn of 1903, however, that I was brought into close working association with him. His associate, Dr. Churchill Carmalt, was then greatly interested in certain work going forward in my laboratory, and on one of his week-end trips to Princeton, he was accompanied by Huntington. It happened that at this time both Huntington and I were actively developing our respective collections in comparative anatomy; through our community of interest in these, there grew the close friendship and professional relationship that existed between us to the end of his life. Very soon we were deeply engaged in joint investigations on two problems of the vascular system. It is because Huntington and I worked so closely on these through a period of twenty odd years, collaborating in the publication of work carried on both together and independently, that I was so intimately acquainted with him professionally and personally, and so was asked to address you this evening on the subject of his life, character and accomplishments.

Rarely is there such a man as George Sumner Huntington. I wish I might draw a picture of him as I really knew him. He began life as a professional anatomist at the time when in this country anatomy was merely an adjunct to surgery; he died as one who had played a leading and dominant rôle in raising anatomy to the high status it now has in America—that of an independent science. We who were well acquainted with him realize that in any field of action he

[1] An address delivered before The New York Academy of Medicine, on January 20, 1928.

had chosen he would have become a leader. Marked physical and mental energy, indomitable perseverance, brilliant intellect, great power of concentration, unbounded enthusiasm—these are characteristics that we all know. Added to these were his charming, magnetic personality, his unfailing loyalty, his great capacity for deep and enduring friendship.

It is interesting to follow the early training and education of a man who, like Huntington, attains real eminence, and to observe the influence that environment may have played in forming his general character, and in moulding him for his chosen profession. While still an infant, Huntington was taken by his mother to Germany and remained there until he had completed his course in the German Gymnasium. He obtained his later education, both college and professional, in this country. The influence of the years in Germany, however, is most evident throughout his life. His thorough and methodical training in the Gymnasium accounts for the exactness and the attention to detail so characteristic of all his investigations. In Germany, too, he acquired his knowledge of the classics and his love for them—a love which he never lost even through the period of his most strenuous scientific career. In later years, when he had occasion to refer to Latin treatises on anatomy and medicine, he was able to read them with great facility. Although his research was of a most highly specialized character, the broad culture of the man was always apparent. Evidently during these early years abroad his mind was directed toward the subject that was to become his profession, for while there he began to collect books on anatomy. These anatomies, collected during his boyhood, with his name and the dates inscribed in them, still form a part of that great collection of books which he has left behind him.

On his return to this country in the autumn of 1877, Huntington was well prepared to enter Trinity College (Hartford) as a member of the class of 1881. Here, as in Germany, his general course continued to be broadly cultural; but the ever-increasing number of electives in chemistry, botany and zoology indicates that he had determined to adopt a scientific career. In his sophomore year he was awarded the Pascal-Fenelon prize for the best examination in Pascal's "Pensées"; in his senior year he received the chemical prize for an essay on explosives. He was graduated with the degree of Bachelor of Arts, *cum honore*, receiving honors in mental, moral and political philosophy, in chemistry and in the natural sciences.

The autumn after his graduation he entered the College of Physicians and Surgeons, then located at Twenty-third Street and Fourth Avenue, New York City. At his graduation from Trinity College, Huntington had ranked seventh in a class of nineteen. In 1884, at his graduation with the degree of M.D. from the College of Physicians and Surgeons, he ranked second in a class of one hundred and twenty-five. In a competitive examination, taken by the first ten men in the graduating class, he won the first prize of five hundred dollars. At the same time he won also a prize for the best clinical reports at the New York Hospital. At the time he had graduated from the College of Physicians and Surgeons, Huntington had given unmistakable indication of the extent of his great natural abilities and of the brilliance of his future career.

After graduation from the medical school, Huntington chose surgery as a profession and entered the Roosevelt Hospital as a member of the House Staff, where he remained until 1886, when he was made an assistant demonstrator of anatomy in the College of Physicians and Surgeons. Between 1886 and 1889, he continued as demonstrator in anatomy; and, for part of this time, assisted Dr. Henry B. Sands in his private practice. He acted also as visiting surgeon to the Bellevue Hospital, as junior assisting surgeon to the Roosevelt Hospital and as chief of clinic of the surgical department of the Vanderbilt Clinic.

In May, 1889, Huntington was appointed to a full-time professorship of anatomy in the College of Physicians and Surgeons. So far as I have been able to determine, no medical school in this country had ever before appointed a man whose full time was given to the teaching of anatomy and to the investigation of anatomical problems. It had been the custom to appoint to the chair of anatomy a man whose time was divided between the practice of surgery and the teaching of anatomy, but whose interest lay chiefly in surgery. As a result the teaching of anatomy had been wholly perfunctory, and no attempt had been made to interpret the structure of the human body in a scientific manner. In America anatomy had not at this time attained that development, that preeminence as a separate science, which already it held in Europe; it was too often presented as a mass of unrelated detail which medical students learned in the hope that at some future time the information might be of practical service. At the time Huntington was called to the chair of anatomy at the College of Physicians and Surgeons, anatomy was entirely subordinate to surgery.

During the three years that he served as demonstrator, Huntington must have been dissatisfied with the prevailing method of teaching anatomy; for in 1889, the year that he was made professor, he abandoned the system then in vogue in all American medical schools—that of giving didactic instruction by lec-

turing to large sections—and substituted teaching by demonstration of the actual objects to small sections of the class. This plan, inaugurated by Huntington, prevails at the present time throughout the country; he was the pioneer in effecting the change. It would have taken a man of no less ability and personal force than Huntington so quickly to revolutionize current methods of teaching. Soon, however, he was to exert a still greater influence by his recognition and application of the fact that anatomy is not an offshoot of surgery, but is a science by itself, and should be regarded and taught as such.

Having reorganized the method of teaching anatomy in the college, he soon recognized the inadequacy of the system in which the subject was presented to the students. Being a close student of evolution and having been deeply influenced by Darwin, Huxley, Owen and Gegenbaur, he now adopted morphology as a means of interpreting the structure of the human body. In doing this he was instrumental in influencing the whole of anatomical study in the medical schools in America; he gave importance to comparative anatomy, and so vitalized the whole subject. There had been other comparative anatomists in this country; Huntington was the first man in America, however, with the vision to see the importance of emphasizing the comparative method in the study of human anatomy, and to make clear the fact that the multitudinous detail which the structure of man offers can be interpreted from the standpoint of the morphology of the different organ systems, and in relation to the application of structure to function. The significance and importance of the structural peculiarities of man he accentuated and illustrated by comparison with the morphology of corresponding structures in the lower vertebrates. In his own words: "There is no region or part of the human body, which is not more readily and permanently comprehended through the comparison with the corresponding structures in the lower vertebrates." With the adoption of the laboratory method of teaching, Huntington radically changed the character and significance of his lectures. The old-fashioned recital of unrelated detail was replaced by a lecture on a much higher plane. Such, in brief, were the new methods of teaching and the general conceptions of anatomy which were initiated by Huntington in 1889, and were consistently followed by him during the thirty-five years that he was professor of anatomy in the College of Physicians and Surgeons.

I have emphasized the methods employed by Huntington in presenting to his students the subject of anatomy. At the time of his appointment as professor, he already had the practical acquaintance with the cadaver and the detailed knowledge of all its parts which were essential to the old-time teacher. When he made comparative anatomy the basis of his new course, however, he was confronted with the necessity of acquiring a first-hand, detailed knowledge of the structure of vertebrates in general; throughout our acquaintance he again and again emphasized his opinion that it is only through observation and practical experience, not through books, that an understanding of anatomy, both human and comparative, is to be gained. He at once began an intensive study of the comparative anatomy of vertebrates, and this work he carried over a period of thirty-five years. The number of vertebrates that he personally examined, dissected and prepared is almost unbelievable; to his associates it has always been a source of wonder how, in addition to attending to numerous other duties, he was able to do work so thorough and detailed on the many animals that came into his possession.

Huntington spent a lifetime in the study of comparative anatomy; in this field no one in America has ever equalled him either in practical experience or in the extent of information. With his experience and his profundity of knowledge, and with his great variety of preparations, Huntington was able to teach and illuminate the subject of human anatomy as before him no one had done in this country. As an inspired and inspiring teacher his name will long remain a tradition in the College of Physicians and Surgeons.

The development of his extensive human and comparative anatomical collection was a natural necessity of Huntington's method of teaching; and, as the collection gradually grew in size and importance, Huntington saw that in its future development he must adopt some definite plan leading to the establishment of what he hoped would be a permanent museum of comparative anatomy. Such a plan was formulated by him and was published in SCIENCE in 1901, under the title: "The Morphological Museum as an Educational Factor in the University System."

The Huntington collection now consists of nearly 6,000 mounted exhibits, practically all of which were prepared and mounted by Huntington himself. In addition to this there is in storage a large amount of material which is classified and catalogued, but remains still to be prepared. The collection is the most extensive and complete of its kind in this country and the technique displayed in the dissection and mounting of the exhibits is unexcelled by any in existence. It was Huntington's intention that in its complete state the collection should constitute a kind of general morphological reference library for the organs and organ systems of vertebrates; for, he says, "In this sense the museum fulfills its highest

functions, stimulating and directly promoting investigation and rendering such investigations fruitful and effective by contributing the series necessary for comparison and reference."

The plan adopted by Dr. Huntington was very comprehensive; it serves to emphasize the thoroughness and attention to detail he invariably displayed in all matters in which he was professionally interested. The facilities for exhibiting the collection in accordance with his plan were notoriously inadequate in the College of Physicians and Surgeons, so that during his lifetime he was unable to organize it along the lines projected. This accounts for his unwillingness to open the collection to the general public, for which in the past he was sometimes unjustly criticized. He had hopes, however, that the foundation laid by him might be built upon by his successors, so that in time and under more favorable conditions, the museum would rank in prestige and in importance to the medical community, as does the Hunterian Museum of Comparative and Human Anatomy in the Royal College of Surgeons in London, now under the directorship of Sir Arthur Keith, the eminent British anatomist. This great Hunterian collection, illustrating both human and comparative anatomy, had its origin in much the same manner as did that of Huntington, and the greater part of the dissections were prepared by the founder, John Hunter. Following this tradition, the Federal Government of Australia has recently founded a National Museum which is to be a center for the advancement of comparative anatomy in its application to modern medical practice. This and the fact that the Hunterian Museum continues to be a growing and active institution, indicates the attitude of British anatomists toward the value of comparative anatomy as a means of elucidating man's structure.

It is to be hoped that the temporary reaction against morphology will not prevent the College of Physicians and Surgeons or some other institution of like standing from carrying out the plan formulated by Huntington and from making the Huntington Museum of Comparative Vertebrate Morphology, like the Hunterian Museum in London, a Mecca for American anatomists.

During the more recent years of his life, Dr. Huntington had observed the rôle played by experiment in influencing the methods of teaching anatomy and the investigation of its problems. It was always fixed firmly in his mind, however, that the experimental aspect of anatomy and of development can not precede the comparative aspect; otherwise, one would have to build and to elaborate theories based on materials he neither knew nor understood. Comparative morphology and experimental morphology are not opposing branches of science, but are complementary methods of attacking one and the same subject. A thorough knowledge of comparative anatomy and of comparative embryology he always maintained is a necessary prerequisite for the experimentalist.

Dr. Huntington has left forty-five publications which were written between 1892 and 1920. In addition to these there are several unfinished manuscripts; and there is one other, completed in 1923, but still unpublished, on the history of anatomy and medicine. These publications cover a wide range in the field of vertebrate morphology, and include investigations on the comparative anatomy and development of the digestive, genito-urinary, respiratory, nervous, muscular, lymphatic and cardio-vascular systems. Seven papers on the development of the vena cava posterior and of the lymphatic system were published jointly with me, between 1903 and 1920.

Between 1892 and 1903, when Huntington was especially interested in developing his teaching and in preparing his museum collections to be used in his course in anatomy, his papers were largely anatomical in character. After 1903, however, his interest was centered primarily on the embryology of the organ systems. His extensive collection of wax reconstructions gives evidence of the vast amount of work he accomplished in this direction.

His earlier investigations dealt largely with the morphology of the digestive system, and between 1892 and 1898 he published a number of papers on this topic. These earlier investigations on the digestive system finally led to the publication of an extensive comparative treatise on the subject, which appeared in 1903 under the title of "Anatomy of the Human Peritoneum and Abdominal Cavity." This book is profusely illustrated by 582 figures, the greater number of which are drawn or photographed from his own dissections. The book well represents Huntington's conception of the value of comparative anatomy and embryology "in elucidating the difficult and often complicated morphological problems encountered in the study of human adult anatomy."

Variations in anatomical configuration as observed especially in different mammals of the same species were always of great interest to Huntington. In this connection a series of five papers were published by him between 1895 and 1904, on variations of the muscular system in the lower primates and in man, with reference to their classification and morphological significance. In his Harvey lecture in 1907, on "The Genetic Interpretation and Surgical Significance of some Variations of the Genito-Urinary Tract," he described such variations of the genito-urinary tract in man as would probably be encountered by surgeons. Here he shows that all such variations can

be interpreted by certain definite and recognized modifications possible in the embryonic ground plan of the genito-urinary tract of mammals.

Among his earlier publications was one appearing in 1898 on "The Eparterial Bronchial System of the Mammalia." It was written in refutation of a theory advanced by Aeby in explanation of the asymmetry which exists in mammals between the right and the left pulmonary arteries and the most proximal branches of the stem bronchi. This paper was the forerunner of a series of others published between 1916 and 1920 on the comparative anatomy and development of the mammalian respiratory organs.

In one of these papers published in 1917 on "The Morphological Basis for the Dominant Pulmonary Asymmetry in the Mammalia" he demonstrates by an embryological study the incorrectness of Aeby's view. He shows that the asymmetry which in the adult exists between the right and the left pulmonary arteries and the bronchial tree, has been brought about in the embryo by a rotation of the gut and the heart in opposite directions. As the result of this rotation the left pulmonary artery is shifted dorsad so that the most proximal branch of the left stem bronchus must necessarily grow out into the interval caudal to or below the left pulmonary artery.

At the time of his death Huntington had almost completed an extensive investigation on the morphology of the lungs of vertebrates, with special reference to mammals. This investigation, which extended over a long period, consists of a comparative study of the development of the lungs of vertebrates. For this he made nearly 500 wax corrosions of the lungs of mammals and of other vertebrates. A large portion of the manuscript, including the plates for figures, is ready for the press and it is to be hoped that funds will be forthcoming to insure its publication, even though the investigation is still uncompleted. Still another important series of investigations made by Huntington deals with the morphology of the salivary glands of mammals. In collaboration with Doctors Churchill Carmalt and Herman Von W. Schulte he published in 1913 a monograph on this subject. His personal contribution to the monograph deals with the development of the salivary glands in the lower primates and gives an interpretation of the primate alveolingual salivary area. This monograph is the most extensive and complete exposition of the subject in existence and must long remain a standard authority.

The above brief outline of some of Huntington's investigations gives a general idea of the character of his work and of the attitude held by him toward the investigation of anatomical problems.

It was in 1903, when his interests were becoming largely centered on embryological problems, that I became associated with Huntington as a collaborator and joined with him, as I have stated above, in making two extensive investigations. At the time of his first visit to Princeton, I was engaged in work on the development of the veins, and especially on the atypical conditions presented by the mammalian posterior vena cava. On account of the interest Huntington showed in my investigation it was suggested that we undertake a joint study. We decided that the development of the veins in the cat furnished material on which to establish an ontogenetic plan that would interpret these atypical conditions. On the basis of this investigation we have been able to classify under 17 main types the variant conditions of the vena cava posterior which in the adult cat are potential; also, we found that all caval variations thus far observed in man could be classed under these same types. This investigation led us directly to one still more important, on the development of the lymphatic system, which occupied us for over 15 years.

In the course of our work on the development of the veins, we observed that the formation of the jugular lymph sacs and thoracic ducts in the cat did not bear out a view advanced in 1902 by Florence Sabin regarding the development of lymphatics in the pig. Accordingly, postponing further work on the veins, we at once transferred our attention to the development of the lymphatic system; and our paper on the development of the veins in the cat did not appear in complete form until 1920.

An examination of any one of the current textbooks on embryology published prior to 1902 will show that up to that time no exact knowledge existed regarding the development of the lymphatic system. It was in 1902 that Florence Sabin advanced the view that the lymphatic system of the pig embryo begins as four blind ducts which in the neck and inguinal regions bud off from the endothelium of the veins and then grow continuously in a centrifugal direction, without discontinuity, throughout the body of the embryo to form the endothelium of the lymphatic system. In other words, she claimed that the endothelium of the lymphatics is invariably derived from the endothelium of the veins.

This view of Sabin's accorded with the angioblast theory of His, who maintained that all intraembryonic endothelium is derived from a unit vascular anlage situated, in the chick embryo, on the yolk sac, from which the endothelium grows continuously, without discontinuity, into and through the body of the embryo. In both these views the idea of the specificity of intraembryonic endothelium is especially involved, since both claim that it comes from a unit vascular anlage and is incapable of arising from any other source or in any other manner.

In 1906 Huntington and I read a joint paper before the American Association of Anatomists in which we maintained that the main lymphatic vessels of the embryonic cat do not develop from the endothelium of the veins, as claimed by Sabin, but develop *in loco,* independently of venous endothelium, from embryonic mesenchyme.

The appearance of this paper marked the beginning of an active controversy which lasted for about fifteen years. Following Sabin's first paper in 1902, nearly 100 others have appeared in substantiation of one or the other view and, with very few exceptions, they have all been written by American anatomists. The living embryo was studied and both the morphological and the experimental methods of investigation were employed.

In the heat of debate one is likely to lose sight of the broader aspects of a question. During the early years the problem was approached chiefly from the standpoint of a unit vascular anlage and of the specificity of lymphatic endothelium alone. Later on, however, as it became apparent that the lymphatic system is merely a part of the general vascular system the problem developed into the broader question of the genesis of endothelium in general, including that of the lymphatics, arteries and veins.

Without entering further into details, it can be stated that as a result of this long controversy, the morphological evidence favoring the local genesis of intraembryonic endothelium from mesenchyme has been completely confirmed by experiment and that the Angioblast Theory of His no longer holds. Furthermore, it is a matter of record that the principle of the local genesis of intraembryonic endothelium from mesenchyme is now generally accepted by anatomists, even by those who at one time most strenuously opposed this view.

Huntington's own personal contributions toward the solution of this problem will continue to be important as long as such pioneer work is of interest to anatomists. The great influence he exerted in stimulating his coworkers and in directing the endothelial problem toward its final solution will not soon be forgotten. He was instrumental in initiating two important experimental investigations by his own associates, McWhorter, Miller and Whipple, in the College of Physicians and Surgeons; these were outstanding contributions in our effort to establish the local genesis view.

The conclusions reached in the investigations which this controversy provoked will ever form a firm foundation on which future investigators may base their work dealing with the genesis of vascular tissues.

Huntington's unusual and striking personality was a dominant factor in his power as a teacher and contributed greatly to his professional success. His sense of humor and his gracious manner endeared him to all who came in contact with him. His innate fineness, his ready sympathy, his keen insight and his broad culture won him friends wherever he went. Every one who saw him was impressed with his vitality, with his indomitable strength—when he was roused in argument, with his alertness and pugnacity and power. Combined with these, he had a charm of virile manhood that is entirely indescribable to any one who did not know and feel it at first hand. All Huntington's activities were characterized by enormous vigor. When a young man, his daily exercise was taken with a professional wrestler. He was an incomparable woodsman and hunter. On his extensive camping trips in Canada, he went without guides, preferring to do all the hard work himself.

In his laboratory, he showed the same indomitable qualities. He loved his work, could never get enough of it. From the time he reached the college in the morning until he left for home at night, he worked incessantly. He was oblivious, insensitive to everything but the idea he was pursuing. In the height of our investigations, he would often in the evening call me over the long distance telephone to compare with me the results that the day's work had brought. It was a joy to collaborate with a man who never failed in eagerness and enthusiasm to share the results of his toil and mine.

At home his hospitality had the charm that characterized his every activity. When sometimes I would accompany him there after long hours of work, he showed no fatigue; his active mind would then often play over ideas that had been occupying us in the laboratory but it was from a new angle. He would comment on the broad aspects of our task, he would laugh over humorous incidents of the day, would sketch plans for the future. The evenings I spent with him by the fireside were among the most delightful of my life.

Although Huntington was that type of intensive individual investigator whose mind is strongly focussed on his own work, I know of no teacher who has been more solicitous for the success of his students, or who has done more to further their interests. He was always ready to discuss their problems and to aid them in their work. During the years that I collaborated with him he was surrounded by a brilliant group of young men; and between the years 1895 and 1919 thirty-nine investigations were published from his laboratory, not including those that he himself wrote. No one could be long with him without being fired by the enthusiasm that he had for his work. Some of the most prominent medical men in this country worked in his laboratory and owe to George Huntington much

of the impulse and ambition that has brought them their professional success. It was always a great pleasure to me to accompany him here and abroad to meetings of the Anatomical Association, where he invariably played a leading rôle. He almost always took part in every discussion; and in debate no one could surpass him when he was discussing his own specialty or other subjects where he was convinced that his opinions were correct. His early experience as a surgeon made him a consultant peculiarly valuable to the medical profession at large; he was alert to the practical significance of his anatomical work, and was always ready to give advice to those who sought it. As an anatomist, as an investigator in fields far removed from surgery, he never lost sight of the fact that the training of surgeons was one of his chief aims. The combination of a professional anatomist of highest standing, with a surgeon of rare skill is unique; in these days of high specialization, it is not likely to occur soon again.

Those of us who were Huntington's intimate friends will always regard him as highly for what he was, as for what he accomplished. His charm of manner, his humor, his deep loyalty to friendships, his masterful energy, his whole dominant personality we shall not forget. He was a rare man, a remarkable friend.

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IDEALS OF THE ENGINEER[1]

IN receiving this great honor, I do so with feelings of deep gratitude and not without a sense of humility, for I realize that the brain of the individual has its limits as a storehouse, and that with knowledge continually increasing, any one mind can take in only a small portion of the rapidly accumulating body of engineering information. In these days, intellectual specialization is absolutely necessary, and whatever I have been able to accomplish is the result of specialization and the cooperation of many individuals.

In order to be of use to society, the ideas of the engineer in every department, in transportation, communication, and architecture, must first be embodied in physical form, and because of this he has achieved such a mastery over material things that he is regarded as preeminently the exponent of a material age. The great utility and economy resulting from his activities are so sensational as to conceal from view the ideals which form the basis of his creative work.

If seeking the truth and applying the truth to the affairs of man is a spiritual thing, then the engineer must be absolved from the charge of materialism. He is an advocate for truth. His works must be tried in the inexorable court of Nature, where no errors are committed and no exceptions granted. The work of the engineer is dedicated to the use of mankind, and the pecuniary compensation which he himself obtains is slight compared with the great benefits received by society. He finds inspiration and reward in achievement, and his real compensation is the good which others derive from what he has done.

Let us consider briefly the ideals of the engineer and the nature of his functions in the light of modern theories of evolution.

We are told that man has come from a lowly origin, and that during ages of time incalculably long he has advanced to his present position at the head of the animal kingdom. It has been supposed that in man himself this evolutionary process is still at work, and that, therefore, in the course of the ages he will evolve into a superlative type, and then perhaps all will go well.

Inasmuch as this evolutionary process in man himself is said to have taken vast periods of time, it is not unreasonable to expect that further ages must elapse before salvation by this form of evolution could be achieved.

Such a view does not afford much comfort nor does it provide any basis for a practical program to guide us. Even speaking in terms of the life of a nation, such a process is too slow. We must reckon with man as he now is. Our problems must be solved by working upon him and through him, and can not wait for the arrival of the hypothetical superman. Indeed, it is stated by an eminent authority that there are no indications that future man will be more perfect in body than the most perfect individuals of the present, or than the most perfect men and women in the days of Phidias and Praxiteles. There seems to be no general agreement as to whether this process in man himself has actually ceased; but I believe it is safe to say, in any event, that it is too slow in its operation to afford a solution of any of the problems that now confront us.

But this is not all that evolution has to offer. For, even if this one pathway should be closed to further great progress during our age, we are assured by that eminent authority, Professor Edwin Grant Conklin,[2] that there are two others which are open to us.

The first of these to be considered is one which is preeminently under the control of the engineer. Conklin tells us that the evolution of man, the individual, is no longer limited to his body or mind;

[1] Address of John J. Carty upon receiving the John Fritz Gold Medal, February 15, 1928.

[2] "The Direction of Human Evolution," Edwin Grant Conklin.

but by adding to his own powers the forces of nature, man has entered upon a new path of progress. The differentiations of various members of a colony of ants or bees, he tells us, are limited to their bodies and are fixed and irreversible. But in human society, differentiations are no longer confined to the bodies of individuals, but have become as it were extracorporeal. And by his control over nature, man has taken into his evolution the whole of his environment. Although he is not as strong as the elephant, nor as deft as the spider, nor as swift as the antelope, nor as powerful in the water as the whale, nor in the air as the eagle; yet by his control of the forces of nature outside of his body, he can excel all animals in strength and delicacy of movement, and in speed and power, on land, in water, and in air.

The true object of engineering is not to create machines to which men will be bound by the chains of necessity, or mechanisms to which they will become slaves. The mission of the engineer is to obtain such a mastery in the application of the laws of nature that man will be liberated and that the forces of the universe will be employed in his service. According to Conklin, this new path of progress is in all respects the most important which has ever been discovered by organisms, and no one can foresee the end of this process of annexing to our own powers the illimitable forces of the universe.

Concerning the other pathway of evolution, he tells us that progress in intellectual evolution, no less than in physical, lies in the direction of increasing specialization and cooperation. But this progress, he says, is no longer taking place within the individual, but in the specialization and cooperation of many individuals. The intellectual evolution of the individual may have come to an end; but whether or not this is true, it is certain that the intellectual evolution of groups of individuals is only at the beginning. In social evolution—the evolution of human society—Conklin says a new path of progress has been found, the end of which no one can foresee.

Progress along this pathway, also, is vitally dependent upon the work of the engineer, for the perfection of all forms of communications and transportation is essential in order that this new super-organism, human society, shall achieve its destiny.

Emphasizing the importance of this, Trotter,[3] another distinguished writer on evolution, tells us that the capacity for free intercommunication between individuals of the species has meant so much in the evolution of man, and will certainly come in the future to mean so incalculably more, that it can not be regarded as anything less than a master element in the shaping of his destiny.

The use of the spoken word to convey ideas distinguishes man from all other created things. It is the function of the engineer to provide for the extension of the spoken word by means of electrical systems of intercommunication which will serve to connect the nervous system of each unit of society with all of the others thus providing an indispensable element in the structure of that inconceivably great and powerful organism which it is believed will be the ultimate outcome of the marvelous evolution which society is to undergo.

There is one element and only one, which stands in the way of the realization of this inspiring vision. That is man himself for he is the unit or cell out of which the new organism is to be evolved. In the individual animal organism, the units or cells are physically joined to each other; but in the social organism, the units are individuals, not physically joined but free to move about at will. The connection between these separate and mobile units is accomplished by communications, which convey information, ideas, and impulses from one mind to another. Whether these communications shall be employed in peaceful, constructive cooperation, or whether they shall be used to engender conflict and confusion, depends upon man himself.

Already, the applications of science to human affairs have far outrun the ability of man to use them wisely. The engineer has provided agencies of incalculable value in time of peace, but they are also endowed with prodigious powers of destruction which can be loosed in time of war. Unless we solve the problem encountered in man himself, the outlook is dark indeed, and it may even be questioned whether our civilization will endure.

Human behavior presents the most important and the most formidable problem of all the ages. Its solution can be achieved only by profound and prolonged researches, which shall bring to bear upon every phase of the subject all of the resources of science.

While, in such a consideration as this, it would be folly to ignore the claims of religion and philosophy, it would be a grave error to conclude that, in order to avoid disaster, we must restrict progress in the application of science to material things. On the contrary, we must accelerate progress in all the sciences, for the knowledge thus gained will be required in preparing the individual man to function as a sane and peaceful unit in the ultimate social organism.

Scientific research in our universities and elsewhere,

[3] "Instincts of the Herd in Peace and War," W. Trotter.

conducted solely for the increase of knowledge, should receive more adequate financial support, so that it may be prosecuted with ever-increasing vigor. If this is done, I believe that in the fulness of time, by further scientific discoveries, the physical development of man will be improved, that many diseases will be entirely eliminated, and that immunity to the others will be achieved, and that feeble-bodiedness and feeble-mindedness will disappear. Thus will be removed some of the greatest barriers to social progress.

In the great plan of evolution, the part assigned to the engineer calls for the highest exercise of his creative faculties, for he is to direct the evolution of man's extra-corporeal powers, providing him with more numerous and still more powerful additions to his feeble bodily equipment.

The ideals of the engineer will not be realized until man has achieved his destiny in that social organism which is foreshadowed "with its million-minded knowledge and power, to which no barrier will be insurmountable, no gulf impassable, and no task too great."

JOHN J. CARTY

AMERICAN TELEPHONE AND TELEGRAPH CO.

SCIENTIFIC EVENTS

CONFERENCE OF LAKE ERIE BIOLOGISTS

SINCE the initiation of active field investigations in Lake Erie by the U. S. Bureau of Fisheries in the summer of 1927, it has become evident that several investigators and research institutions are already interested in biological research in these waters and that others are either planning to undertake such studies or are in a favorable position to do so.

To stimulate interest in Lake Erie and to center attention upon fisheries conservation, the commissioner of fisheries called a conference of the various biologists working independently or as members of the staffs of research institutions and universities with the hope of effecting closer coordination of the work and to prevent duplication of effort. Dr. Francis H. Herrick, of Western Reserve University, offered the facilities for the meeting, and the conference, therefore, was held in Cleveland on February 6.

The New York Conservation Department was represented by Alexander McDonald, commissioner, and Dr. Emmeline Moore; Dr. R. H. Pegrum represented the Buffalo Society of Natural Sciences; N. R. Buller, Fisheries Commissioner of Pennsylvania, was present; Dr. R. C. Osburn, of Ohio State University; E. L. Wickliff, W. M. Tidd, and M. K. Young, of the Ohio Division of Fish and Game, and Dr. R. V. Bangham, of Wooster College, Wooster, Ohio, also were present. A number of the faculty of Western Reserve University attended, including Dr. Herrick and Dr. J. Paul Visscher. The Ohio State Department of Health was represented by Messrs. B. F. Hatch and Paul Mason; G. F. Simmons represented the Cleveland Museum of Natural History. Michigan was represented by C. L. Hubbs, curator of fishes of the State University, and the Province of Ontario by W. J. K. Harkness and J. L. Hart, of the University of Toronto. Besides Commissioner Henry O'Malley, who presided at the conference, the Bureau of Fisheries was represented by Lewis Radcliffe, Elmer Higgins, Dr. John Van Oosten, Stillman Wright and E. J. McClure. In addition to these official delegates a number of commercial fishermen and fish merchants evidenced their interest in the solution of fishery problems in Lake Erie by attending the conference and entering into the discussions.

After an address of welcome by Dr. Herrick, Mr. O'Malley took the chair and the following program was taken up:

1. Conservation in Lake Erie and the need for cooperative investigation, Henry O'Malley.
2. The condition of the Great Lakes fisheries, Lewis Radcliffe.
3. Review of the present state of knowledge concerning the biology of Lake Erie, Dr. R. C. Osburn.
4. Biological problems in Lake Erie, Dr. C. J. Fish (read by Dr. R. H. Pegrum).
5. Survey of research programs and research facilities:
    a. State of New York, Mr. McDonald and Dr. Moore.
    b. Buffalo Museum of Natural Sciences, Dr. Pegrum.
    c. State of Pennsylvania, N. R. Buller.
    d. State of Ohio, Dr. R. C. Osburn.
    e. Western Reserve University, Dr. J. Paul Visscher.
    f. University of Toronto, W. J. K. Harkness.
    g. University of Michigan, Carl L. Hubbs.
    h. U. S. Bureau of Fisheries, Dr. John Van Oosten.
    i. Other agencies:
        1. Cleveland Museum of Natural History, G. F. Simmons.
        2. Ohio State Board of Health, B. F. Hatch.

The fisheries situation in Lake Erie and the need for further investigations were discussed freely by various members of the conference. In surveying the research programs and research facilities of the various organizations it was apparent that the States of New York and Ohio are contemplating further investigations in Lake Erie on an extensive scale during the coming year. Included in the program of the State of New York is the employment of personnel from several cooperative institutions, such as Cornell University, Syracuse University, Rensselaer Polytechnic Institute and the Buffalo Museum of Natural Sciences. At the western end of the lake the Ohio Division of

Fish and Game is joining forces with the state university and the Franz Theodore Stone Laboratory in conducting studies there. In the central part of the lake the Fish and Game Department of Pennsylvania has promised cooperative action, together with the biologists of Western Reserve University. The province of Ontario is unable to cooperate actively because of the fact that biologists of the University of Toronto are already engaged in fishery problems in Lake Ontario; and while undertaking no active field work, the University of Michigan offers cooperation in problems concerning technical ichthyology. The bureau's staff of investigators, under the direction of Dr. John Van Oosten, is being built up, and by early summer seven workers will be engaged in investigations dealing directly with the fisheries.

At the close of the discussions, in which every one was given opportunity to express his views, it was determined that the Commissioner of Fisheries should appoint an executive committee to draft plans for coordinated research on Lake Erie, based on the individual plans submitted. Mr. O'Malley appointed Elmer Higgins chairman and Drs. R. C. Osburn and Emmeline Moore as members of this committee with instructions to draft the program and refer it back to the individual cooperative investigators for their approval and action. The committee was directed further to prepare a bibliography on equipment, with special reference to experimental fishing gear, and to make an effort to standardize collecting equipment among the investigators as far as possible. It is believed that material progress has been made in stimulating research on the problems of conservation and the rebuilding of a valuable but sadly depleted fishery in Lake Erie.

Elmer Higgins

U. S. Bureau of Fisheries

MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY

The American Electrochemical Society will hold its annual meeting at Bridgeport, Conn., on April 26, 27 and 28. This district was chosen owing to the epochmaking developments in the electric manufacture of brass. The president of the society is Professor S. C. Lind, head of the department of chemistry of the University of Minnesota and the American representative of the International Radium Standards Commission. Professor Lind will show the members a number of gas reactions brought about by radium emanations.

On April 26, the society will convene at the new Hotel Stratfield, and will devote Friday morning to the discussion of electric heating, molting and electric furnace linings. Among those who will participate in this discussion are Mr. R. E. Talley, president and chief engineer of George J. Hagan Company, Pittsburgh; Mr. R. M. Keeney, industrial heating engineer of the Connecticut Light and Power Company; Mr. John L. Christie, metallurgist of the Bridgeport Brass Company; Dr. B. D. Saklatwalla, vice-president of the Vanadium Corporation of America, and others.

The Thursday morning session at the Hotel Stratfield will be devoted to a discussion of new batteries, and Dr. George W. Vinal, of the U. S. Bureau of Standards, will preside. Owing to the development of the radio industry, the battery business has increased by leaps and bounds. The Burgess Laboratories of Madison, Wisconsin, will present the results of their latest discoveries. The storage battery will be analyzed by experts in this field, and there will be reports on improved types of wet primary cells such as the Edison and Waterbury cells. Finally, there will be a demonstration of new rectifiers and eliminators. On Thursday afternoon the members will proceed upon a tour of inspection of the factories in Bridgeport and vicinity. On Thursday evening there will be a public lecture by Professor Bergen Davis, of Columbia University, who will demonstrate the use of the X-ray in the study of metals and compounds.

The local committee is headed by Mr. John L. Christie, metallurgist of the Bridgeport Brass Company. Mr. Christie has been working for many weeks in arranging for plant visits and social functions. Other members of his committee include the following: Messrs. F. M. Turner, Charles J. McElroy, W. G. Stratten, Raymond O'Connor, W. O. Mitscherling, Karl Pitschner, Walter M. Bradley, William Delage, George B. Hogaboom and J. C. Bradley. The main social event of the electrochemists' convention will be a dinner and dance on Friday evening.

The final session will be held Saturday morning, and will be devoted to the presentation of papers on electroplating of nickel, gold, silver, chromium and thallium. Professor E. M. Baker, of the University of Michigan, and expert for the G. C. Spring and Bumper Company, will preside over this session.

ELECTION OF FELLOWS TO THE ROYAL SOCIETY OF EDINBURGH

The following candidates have been recommended by the council for election as Fellows of the Royal Society of Edinburgh:

Baker, Edwin Arthur, assistant at the Royal Observatory, Edinburgh; Barbour, George Brown, professor of geology, Yenching University, Peking, China; Brown, Hugh Wylie; Bruce, William Straton, parish minister of Banff; Clark, Alfred Joseph, professor of materia medica in the University of Edinburgh; Coutie, Alexander, assistant in the chemistry department, University of Edin-

burgh; Cumming, William Murdoch, senior lecturer on organic chemistry, Royal Technical College, Glasgow; Dawson, Warren Royal, fellow of the Royal Society of Medicine; Fenton, Edward Wyllie, lecturer in agricultural botany, Edinburgh and East of Scotland College of Agriculture; Forrest, James, lecturer in physics, University College, Dundee; Fraser, John, Regius professor of clinical surgery in the University of Edinburgh; Fraser, Kenneth, deputy county medical officer of health, Cumberland; Harding, William Gerald, Christ Church, Oxford; Hobson, Alfred Dennis, lecturer in zoology in the University of Edinburgh; Hodge, William Vallance Douglas, lecturer in mathematics in the University of Bristol; Hunter, Arthur, vice-president and chief actuary of the New York Life Insurance Company; Johnston-Saint, Percy Johnston, secretary, Wellcome Historical Medical Museum, London; Johnstone, Robert William, professor of midwifery and diseases of women in the University of Edinburgh; Jones, Tudor Jenkyn, lecturer in anatomy in the University of Liverpool; MacDonald, Thomas Logie, secretary of the West of Scotland branch of the British Astronomical Association; Mackie, Thomas Jones, professor of bacteriology in the University of Edinburgh; Matthai, George, professor of zoology, the Government College, Lahore, India; Nichols, James Edward, research assistant in genetics at the animal breeding research department, University of Edinburgh; O'Donoghue, Charles Henry, lecturer in zoology in the University of Edinburgh; Percival, George Hector, assistant physician, skin department, Royal Infirmary, Edinburgh; Pilcher, Robert Stuart, general manager and engineer, Edinburgh Corporation Tramways and Motors; Price, Charles Edward, formerly M.P. for Central Edinburgh; Roberts, Owen Fiennes Temple, lecturer in astronomy and meteorology in the University of Aberdeen; Senior-White, Ronald, malaria research officer, Central Malaria Bureau, Kasauli, India; Smith, Alick Drummond Buchanan, assistant animal breeding research department, University of Edinburgh; Watters, Alexander Marshall, rector of Hawick High School; Whittaker, John Macnaghten, senior scholar of Trinity College, Cambridge, and lecturer in mathematics in the University of Edinburgh; Williamson, John, lecturer in mathematics in the University of St. Andrews.

NEW CHAPTERS OF THE SOCIETY OF SIGMA XI

THE Arizona chapter of the Society of Sigma Xi was installed at the University of Arizona on the afternoon of February 22, Dr. W. F. Durand, of Stanford University, acting in the capacity of installing officer. In the evening a banquet was held, followed by the first Sigma Xi lecture, entitled "Science and Civilization," by Dr. Durand. The officers of the newly-installed chapter are: Dr. P. S. Burgess, *president;* Dr. G. T. Caldwell, *vice-president,* and Dr. H. B. Leonard, *secretary-treasurer.*

The college of medicine of the University of Illinois chapter of the Sigma Xi was installed on March 9 by the national president, Dr. F. R. Moulton, and Professor George Baitsell, of Yale University, head of the executive committee. There are twenty-eight charter members. Dr. D. J. Davis, dean of the college, was elected president, and Dr. William H. Welker, *secretary;* Dr. I. Pilot, *treasurer,* and Drs. William F. Petersen, H. A. McGuigan and Dr. V. E. Emmel *to membership in the executive committee.*

A chapter of the Society of the Sigma Xi was installed at the Kansas State Agricultural College on March 3. The chapter members, 58 in number, were all alumni members of Sigma Xi, representing 22 different institutions. The installing officer, Professor George A. Baitsell, of Yale University, gave the installation address on the subject "Coagulation in its relation to Tissue Formation."

There has recently been organized at Louisiana State University a Sigma Xi Club composed of nineteen members from the departments of botany, chemistry, geology, mathematics, physics, zoology and the experiment station. The purpose of the club is to further the advancement of research in the university and to give the university community the opportunity when possible to hear prominent speakers on scientific subjects.

SCIENTIFIC NOTES AND NEWS

PRESENTATION of the Bruce medal of the Astronomical Society of the Pacific to Dr. Walter S. Adams, director of the Mount Wilson Observatory, will be made on April 16 by Dr. W. W. Campbell. On this occasion Dr. Adams will give an address on "The Past Twenty Years of Physical Astronomy."

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the Vienna Microbiological Society.

IN recognition of his distinguished service to the British government in the field of tropical medicine, the honor of knighthood has been conferred on Dr. Aldo Castellani, professor and director of the department of tropical medicine, Tulane University of Louisiana School of Medicine, and director of tropical medicine and physician in the Ross Tropical Institute and Hospital, London.

DR. ARISTIDES AGRAMONTE, of Havana, who was a member of the group of army officers—Reed, Carroll, Lazear and Agramonte—which was appointed by the United States to conduct the yellow fever investigation in Cuba, at a special meeting of the faculty, members of the American College of Physicians and students and citizens of New Orleans, was awarded the degree of doctor of laws by Tulane University.

THE Academy of Natural Sciences of Philadelphia announces that its committee on the Joseph Leidy

Memorial Award for 1928 has selected Dr. Henry Augustus Pilsbry, chief of the department of mollusca at the academy, as the recipient of the award. The report of the committee states that "the award is made in recognition of his researches on the phylogeny of the terrestrial mollusca, in which field he is universally regarded as a leading authority, and for his work on the classification of the Cirripedia which constitutes the most notable contribution to the subject in recent years." The award consists of a bronze medal and honorarium, given once in three years for outstanding work in the natural sciences. It was founded in 1923 and its first recipient, in 1925, was Dr. Herbert Spencer Jennings, of the Johns Hopkins University. The committee which made the 1928 award consisted of Dr. Witmer Stone, *chairman,* Dr. Edwin G. Conklin, Dr. William B. Scott, Dr. J. Percy Moore and James A. G. Rehn.

S. G. BLAYLOCK, general manager of the Consolidated Mining and Smelting Company of Canada, will be the recipient this year of the James Douglas medal, awarded annually by the American Institute of Mining Engineers for distinguished achievement in nonferrous metallurgy.

THE Thomas Hawksley gold medal of the British Institution of Mechanical Engineers has been awarded to H. L. Guy for his paper entitled "The Economic Value of Increased Steam Pressure," which was presented in November, 1926.

BOYLE medals have been awarded by the council of the Royal Dublin Society to Dr. W. R. G. Atkins (pure science) and to Professor W. E. Adeney (applied science) and were presented at a special scientific meeting of the society on February 15.

DR. JOHN H. MUSSER, professor of medicine at Tulane University, was elected president-elect of the American College of Physicians at the New Orleans meeting on March 8; Drs. Aldred S. Warthin, Ann Arbor, and Solon Marx White, Minneapolis, were reelected vice-presidents; Dr. Williams McKim Marriott was elected third vice-president, and Drs. Clement R. Jones, Pittsburgh, and George M. Piersol, Philadelphia, were reappointed treasurer and secretary-general, respectively.

DR. EDWARD L. KEYES, professor of clinical surgery at the Cornell University Medical College, has been elected president, and Dr. Donald R. Hooker, of Baltimore, secretary, of the American Social Hygiene Association for 1928. Dr. William H. Welch is honorary president.

PROFESSOR R. C. WALLACE, of the University of Manitoba, has been made chairman of the Manitoba hydro-electric commission.

DR. ANDREW M. SOULE, president of the State College of Agriculture, Athens, Ga., has been named president of the Southern Appalachian Power Conference.

RAPHAEL ZON, director of the Lake States Forest Station at St. Paul, has been transferred to Wisconsin and has been appointed non-resident professor in the university. He will direct forestry investigations under the supervision of the Wisconsin Conservation Commission, the United States Forest Service and the State College of Agriculture. The experiments will be conducted in different sections of the state.

DR. CLIFFORD L. DERICK, assistant resident physician at the Rockefeller Hospital, New York City, has been appointed physician to the Peter Bent Brigham Hospital, Boston, Massachusetts, to succeed Dr. Cyrus C. Sturgis, recently appointed professor of medicine at the University of Michigan.

DR. A. L. MELANDER, head of the department of biology in the College of the City of New York, has declined the post of state entomologist for New York.

COMMANDER JOHN C. THOMPSON, doctor at the Pearl Harbor Navy Yard; W. M. Giffard, amateur entomologist, and Bruce Cartwright, student of Hawaiian ethnology and history, have been appointed research associates on the staff of the Bernice P. Bishop Museum, Hawaii.

DR. H. E. BARNARD recently resigned the presidency of the American Institute of Baking, and has organized the firm of H. E. Barnard, Inc., in Indianapolis, for consultation on problems relating to food production.

DR. C. L. SHEAR, who spent the past winter collecting fungi in the Hawaiian Islands, is expected to arrive in Washington sometime during April. Dr. Neil E. Stevens, who accompanied Dr. Shear during much of his trip, devoted especial attention to the diseases of strawberries.

DR. H. A. GLEASON, of the New York Botanical Garden, sailed on March 22 for Europe, and will devote the ensuing six months to a continuation of his studies on the flora of British Guiana.

MAURICE H. BIGELOW, of Concord, Mass., who for the past three years has been head of the department of sciences in the American College of Salonica, Greece, plans to return in June, to engage in industrial chemistry and to give a course of lectures on "Industrial Openings in the Near East."

THE third course of two lectures under the Morris Herzstein lectureship on diseases of the Pacific Basin including tropical diseases will be given by Dr. Rich-

ard P. Strong, professor of tropical medicine of the Harvard Medical School, on May 2 and May 3, at the Stanford Medical School. The title of Dr. Strong's lectures will be "Recent Advances in Tropical Medicine."

The first address under the Abner Wellborn Calhoun lectureship of the Medical Association of Georgia will be given on May 9, by Dr. George E. de Schweinitz, of Philadelphia, on "Headaches."

Professor Lyman C. Newell, of Boston University, will deliver the address at the exercises commemorating the one hundred and seventy-fifth anniversary of the birth of Count Rumford which will be held on March 26 at Woburn, Mass., where Count Rumford was born. The title of the address is "Count Rumford—Scientist and Philanthropist."

Dr. George Barger, professor of chemistry, University of Edinburgh, lectured at the Medical School of Harvard University, on March 9, on "Thyroxine and the Thyroid Gland." On March 16 Dr. Barger gave a lecture on the same subject before the New York University chapter of the Sigma Xi.

Dr. Dean D. Lewis, professor of surgery in the Johns Hopkins University, delivered the Hodgen lecture on March 20, before the St. Louis Medical Society on "Reconstruction Surgery."

V. K. La Mer, assistant professor of chemistry at Columbia University, lectured on "The Influence of Electric Properties on the Behavior of Solutions" before the Cleveland, Columbus, Cincinnati, Ann Arbor and East Lansing, Michigan, sections of the American Chemical Society from March 9 to 16. His lecture before the Indianapolis section on March 14 dealt with "Oxidation Potentials and their Biological Significance."

Professor Chancey Juday, of the University of Wisconsin, gave a public lecture at the University of Michigan on March 9 on "Recent Aspects of Limnology."

Dr. C. J. Davisson, of the Bell Telephone Laboratories, Inc., addressed the Franklin Institute on March 21 on "Are Electrons Waves?"

Dr. O. E. Meinzer, of the U. S. Geological Survey, recently delivered a lecture entitled "Well Water and Well Problems in Different Parts of the United States," before the Illinois Water-Well Drillers Association, in Urbana, and the Minnesota Well Drillers Association, in Minneapolis.

Dr. Robert G. Aitken, associate director of the Lick Observatory, addressed the Astronomical Society of the Pacific on March 19 on "Multiple Stars."

Dr. Oscar Riddle, of the Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y., addressed a meeting of the section of biology of The New York Academy of Sciences on March 12 on "Studies on Thyroids and Gonads."

Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, lectured on "The Earth's Magnetic Charge" at the meeting of the American Institute of Electrical Engineers in New York on February 13, and also on "Recent Theories of the Atom" at the joint meeting of the Physical Society and Optical Society at Columbia University on February 24.

The thirteenth Guthrie lecture before the British Physical Society on electrodeless discharge through gases was given by Sir Joseph Thomson on March 9 at the Imperial College of Science and Technology, South Kensington.

The Romanes lecture at the University of Oxford for this year will be delivered by Dr. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy in University College, London, on May 4. His subject will be "Paleontology and the Origin of Man."

As a tribute to the thoroughness and accuracy of the exploratory and geological investigations of the late Dr. G. M. Dawson, at one time a member and later director of the Geological Survey of Canada, a monument is to be erected by Mr. Fenley Hunter, of New York, on the bank of the Liard River in Yukon territory.

It was announced on March 14 that the half-way mark had been passed in New York's quota of $500,000 toward the completion of the $2,000,000 Leonard Wood memorial for the eradication of leprosy.

Dr. Thomas Bruce Freas, professor of chemistry at Columbia University, died on March 15, aged fifty-nine years.

Charles Wilson Easley, professor of chemical engineering at Syracuse University, died on January 27, at the age of fifty-two years.

Austin Bradstreet Fletcher, consulting engineer for the Bureau of Public Roads of the U. S. Department of Agriculture, died on March 8, at the age of fifty-six years.

Sir Dawson Williams, who retired last January from the editorship of the *British Medical Journal* after thirty years of distinguished service in that office, died on February 27, aged seventy-three years.

A correspondent writes that Professor Charles Walter Howard, who in September last returned to

this country from China to head the department of zoology at Wheaton College, died on March 1 from injuries received when he was struck by an interurban trolley. Professor Howard was an entomologist of wide experience in this country, in Africa and in China. For the past eleven years he was connected with Lingnan University at Canton and since 1923 he was director of the Government Bureau for the Improvement of Sericulture in Kwongtung Province, a position which he held at the time of his death. He was fellow of the London Entomological Society and member of the Pan-African Trypanosomiasis Commission and was a member of the First International Congress of Entomology held in Brussels in 1909. He was to have served as chairman of the sericultural section of the Fifth International Congress of Entomology, meeting in August of this year in Ithaca.

The annual meeting of the Kentucky Academy of Science will be held on May 12 at the University of Kentucky. The invited speaker will be Dr. E. C. Stakman, plant pathologist of the University of Minnesota, who will also represent the American Association for the Advancement of Science at the meeting. Dr. A. M. Peter, of Lexington, is secretary of the academy and the division secretaries are: Physical sciences, Professor C. S. Crouse, University of Kentucky; biological sciences, Professor E. N. Fergus, Experiment Station, Lexington; philosophy and psychology, Dr. M. A. Caldwell, University of Louisville.

A group of scientific men at Princeton who are interested in "analysis situs" is organizing an informal conference on the subject immediately preceding the April meeting of the American Mathematical Society in New York City. At that meeting there will be held an extensive symposium on all phases of analysis situs, but it is believed that a conference such as planned will provide closer contact and a more thorough exchange of ideas than can take place at a general meeting of the society. The topic to be considered will be "The Ideal Organization of the Subject Matter of Analysis Situs as it Stands To-day." There is, however, no idea of holding to this subject should the discussion develop in some other direction. The formal meetings of the conference will take place on Wednesday and Thursday, April 4, 5, at 2:30, Room 312, Palmer Physical Laboratory. In addition to the members of the Princeton group (Alexander, Alexandroff, Hopf, Lefschetz and Veblen) the participation of Professors Chittenden, Kline and Morse has been assured.

At the annual council meeting of The History of Science Society, held in New York at Teachers College, Columbia University, on February 25, officers for the year were elected as follows: *President,* Dr. Edgar F. Smith, University of Pennsylvania; *Vice-Presidents,* Dr. John C. Merriam, Carnegie Institution of Washington, and Dr. James Harvey Robinson, 173 Riverside Drive, New York; *Recording Secretary,* Dr. Harry Elmer Barnes, Smith College; *Corresponding Secretary* and *Treasurer,* Mr. Frederick E. Brasch, Library of Congress; *Editor of Isis,* Dr. George Sarton, Harvard University; Members of the Council to serve until 1930, Dr. J. McKeen Cattell, editor of Science; Dr. Florian Cajori, University of California; Dr. George S. Brett, Toronto University; Dr. Lao G. Simons, Hunter College, New York, N. Y., and Dr. C. A. Browne, U. S. Bureau of Chemistry.

The Civil Service Commission announces an examination for the position of chief of the Bureau of Dairy Industry, Department of Agriculture. The examination will consist solely of the consideration of qualifications by a special examining board. The entrance salary for the position is $6,000. Applications must be on file with the commission in Washington not later than April 3.

UNIVERSITY AND EDUCATIONAL NOTES

The Columbia University-Presbyterian Hospital Medical Center, which has been under construction for three years, was opened to public inspection for the first time on March 16. Six units were opened. They were the Presbyterian Hospital, the Sloane Hospital for Women, the Squier Urological Clinic, the Presbyterian Hospital School of Nursing Practice, the Harkness Pavilion and the Anna C. Maxwell Hall for Nurses. On March 19 the Presbyterian Hospital will begin to move to its new quarters. The College of Physicians and Surgeons, the School of Dental and Oral Surgery and the State Psychiatric Institute will move to the Center during the coming summer.

Gifts amounting to $2,000,000 have been made to the $15,000,000 endowment fund for the six American colleges in the Near East since the nation-wide campaign for funds started on December 2. These gifts bring the total endowment up to $8,010,760, plus the $1,000,000 from the Rockefeller Foundation for Medical Work at the University of Beirut.

Ground has been broken at the University of Washington for a new physics building to be built at a cost of $465,000. This will be the first unit of a science group at the university. The building, a four-story structure of Gothic design, will cover an area of 80 by 230 feet and will be from 50 to 60 feet in height. The building is expected to be ready for occupancy by November of this year.

According to the *Journal* of the American Medical Association, Tokyo Imperial University has decided to

establish a course in hormone chemistry in the medical department beginning in April. This is said to be the first course of its kind. The cost of maintaining the laboratory for the course has been donated by the Society for the Advancement of Pharmacology in an amount believed to be between 200,000 and 300,000 yen. Dr. Akira Ogata will be promoted to the rank of professor and placed in charge of the laboratory; he has been studying hormone chemistry in Europe for two years.

WILLIS A. SLATER, engineering physicist of the U. S. Bureau of Standards, has been elected research professor of engineering materials and director of the Fritz engineering laboratory in the department of civil engineering at Lehigh University.

DR. BENJAMIN ALLEN WOOTEN, professor of physics at Washington and Lee University, has been appointed head of the department of physics of the University of Alabama. Dr. Robert W. Dickey, professor of electrical engineering in the university, will replace Dr. Wooten as head of the physics department for the coming year.

DR. T. L. PATTERSON, professor of physiology at the Detroit College of Medicine and Surgery, has been appointed acting professor of physiology for the summer quarter of 1928 at Stanford University and will be located at the Hopkins Marine Station, Pacific Grove, California.

THE summer session of Cornell University, which will open on June 30, will have on its teaching staff thirty professors from colleges and universities in addition to regular members of the Cornell faculty. These include in geography and geology: Dr. Collier Cobb, of the University of North Carolina; Professor Harry Leighton, of the University of Pittsburgh; Dr. J. P. Rowe, of the University of Montana; Professor M. H. Stow, of Washington and Lee University. In physics: Dr. William F. G. Swann, of the Franklin Institute; Professor Robert E. Loving, of Richmond College; Carl A. Heeler, of Columbus, Ohio.

WILSON F. BROWN, instructor in chemical engineering at the Ohio State University, has been appointed to an associate professorship at the Kansas Agricultural College to take charge of the work in industrial chemistry and chemical engineering.

THE electors to the newly-established Rouse Ball professorship of mathematics at the University of Cambridge have elected John Edensor Littlewood, F.R.S., fellow of Trinity College and Cayley lecturer in mathematics, to the professorship.

DR. GEORG B. GRUBER, of Innsbruck, has been appointed professor of pathology at Göttingen.

DISCUSSION AND CORRESPONDENCE

OXIDATION-REDUCTION REACTIONS

IN a recent delightful address of Professor Albert P. Mathews[1] he states that it remained for the *physical chemist* to discover what was really at the bottom of oxidations, namely, that when an oxidation takes place one or more electrons are lost by the substance oxidized. This view does, indeed, prevail to-day but in the numerous recent papers which have been written to explain oxidation in the light of the electron theory, no one, apparently, has attempted to trace back this idea to its origin. The reason for this is probably that the original publication took place long before the electron theory had been enunciated and our present conception of oxidation-reduction reactions was not due at all to one who might be called a "physical chemist."

In the third edition of Douglass and Prescott's "Qualitative Analysis," published in 1880, special attention is called to the chapter on oxidation-reduction written by Otis Coe Johnson on the basis of the theory of *negative bonds.* This section appears as Part IV of the fourth edition published in 1883, and the section by Johnson is mentioned on the title page of this fourth edition as well as in the preface to the third edition. Later editions of this well-known book bear the name of Prescott and Johnson as authors. If one substitutes the word *electron* for what Johnson called a *negative bond,* it is clear that his theory is exactly the same as that which has been rediscovered by so many of the younger chemists during recent years. Inasmuch as it is not very far-fetched to call an electron a negative bond, it seems rather remarkable that Johnson in 1880 should have anticipated so closely the present electronic conception of oxidation.

Another statement occurs in Professor Mathews' address which illustrates how long an old theory will persist in literature. He writes "And when the electrical and electronic nature of valence was finally understood, *a few years ago,* it was seen that in every case of oxidation the oxidized substance lost a negative electron and thus gained a positive charge, in other words in every oxidation there is always a *flow of positive electricity, since the current is always supposed to be in the direction of movement of the positive, from the oxidizing to the oxidized body.*"

Such a statement is likely to lead to confusion. Since even the high-school pupil of to-day knows that the so-called "flow of electricity" is theoretically a flow of electrons, it is absolutely inconceivable that there should be such a thing as a flow of positive electricity. It is quite true that some fifty years or so

[1] "Some Applications of Physical Chemistry to Medicine," SCIENCE, 66, 606, 1927.

ago there was a single fluid theory which was practically the reverse of our present electron theory. In terms of this old theory, the positive electricity flowed in the positive to negative direction. According to a later theory, the positive electricity moved in one direction and the negative electricity in the other, but now this double fluid theory has been discarded and it is quite generally believed that only the negative electricity moves in the passage of an electric current through, or over, a wire and in oxidation-reduction reactions. To be sure, a positively-charged body is attracted to a negatively-charged one, and if the former is fixed in position, as the cathode when dipped in an electrolytic cell, then the positively-charged body will move, but in every case of a transfer of electricity it is the light electron that changes position and never the heavy proton. Consequently, in oxidation-reduction reactions there is a flow of negative charges from the reductant to the oxidant and never a flow of positive electricity from the oxidizing to the oxidized body.

Teachers who persist in indicating the direction of an electric current in terms of discredited theories help to bring confusion into the minds of their pupils.

WILLIAM T. HALL

PSEUDO-ARTIFACTS FROM THE PLIOCENE OF NEBRASKA

IN SCIENCE of May 20, 1927, there appears, on page 482, a genealogical diagram by Henry Fairfield Osborn, showing his recently modified conception of the origin of man and of his culture. Near the base of the family tree is indicated the geological position of the well-known Hesperopithecus tooth and of certain accompanying fossil bone fragments, thought to be implements. Indirect textual references to the latter are to be found in the same issue (Science News, page xiv) and also in SCIENCE of May 6 (Science News, page x).

In SCIENCE of December 16, Professor W. K. Gregory published a belated article setting forth his matured views regarding the famous tooth under the explanatory title, "Hesperopithecus apparently not an Ape nor a Man." It seems timely, therefore, that available observations on the associated bone "implements" should also be made known without further delay and I accordingly submit my findings as originally set down in August.

The occurrence of anthropoid remains in the Snake Creek beds at Aldine, Nebraska, being still under dispute, the existence in these Pliocene deposits of bone objects suggestive of a tool-making being becomes a subject calling for more than ordinary caution. Observation, unfortunately, is further limited by the fact that in the absence not only of human skeletal remains and of hearth-sites, but also of stone implements such as could have been used in the production of bone artifacts, the question of man's presence comes to depend entirely on the evidence furnished by the peculiar bone specimens themselves.

Having been requested for an opinion concerning these bones, it was at once assumed that the occasion demanded something decisive. The entire available collection—or rather selection—has therefore been subjected to systematic study. To check my own observations, the material was looked over independently by a laboratory assistant who had previously shown some aptness, *e.g.*, in detecting frauds among our old Indian collections. More precisely stated, this examination involved the scrutiny of nearly 3,000 specimens with a magnifying glass and by the aid of the best obtainable light. In short, all reasonable mechanical precautions have been observed. By way of further precaution I have also, as a matter of course, asked myself these questions: What now is it you are looking for? What precisely are the standards by which you are to measure these specimens? Expressed in other terms, what are the diagnostic characters indicating bone artifacts?

Without giving a complete inventory of primitive bone implements and ornaments, it may here suffice to say that implements divide into two major groups or classes, *viz.*, sharp-pointed and sharp-edged. The ornaments, or at any rate the objects less distinctly utilitarian, separate into tubular forms (cylindrical beads, flutes, etc.), and thin flat forms of varying outlines, rectilineal and curvilineal. And what distinctive features normally characterize each and all of these four outstanding classes of objects? First of all, a certain more or less easily recognizable shape or design. In the second place, implements are generally marked by evidences of wear, often resulting in a high degree of polish. Generally, too, they are marked by abrasions, if not actual perforations; and they almost invariably show certain unmistakable straight-line cuts and scratches running diagonally or transversely across the natural striations of the bone itself. Assuming, therefore, that the bone specimens to be examined were worked or utilized in a fresh state, and that at least some of the more deep-going evidences of artificial treatment have been preserved in the fossilized objects now available, we have remaining these criteria: shape, wear, polish, cutting marks, chopping marks, abrasions and perforations. These are perhaps not infallible proofs but they are all that we have. In matters of observation pertaining to objective facts no man is entitled to call up a standard for judgment out of his own inner consciousness.

By the light, then, of these deliberate precautions, the cursory examination of all the material and the repeated critical study of the several suspect pieces were undertaken. The result is, in brief, that I find no positive evidence either of intentional design or of artificial workmanship.

It is true there are several pointed forms resembling awls and also some tubular bone sections resembling beads, which, if found, say, in an Indian shell-heap would cause a careful archeologist to look at them several times before discarding them. But, after all, aside from their suggestive shape—simulating not finished articles but rather improvised forms often adapted from accidental bone fragments—they carry none of the real telltale marks above enumerated. When, therefore, it is alleged (Science News, May 10, p. xiv) that "eighteen of the [Nebraska] types of tools have been matched with counterparts found in the ruins of cliff-dwellers," two observations become imperative. One is, that with two exceptions—awls and tubular beads—the "eighteen counterparts" are not designed tools or ornaments but merely accidental fragments, a few of which have served temporary purposes. The other is that the "matching process" referred to involved on the discoverer's part the culling over of many thousands of fossil bone fragments. We have here, in other words, a close parallel to the selective procedure of which Europeans have made so much in the accumulation of eoliths. But, as in the case of eoliths, it is pertinent here to remark that given the proper raw materials and the right natural conditions for their manipulation, nature produces many things more or less suggestive of human handiwork, and the collector by taking pains can easily gather an array of imitations which considered by themselves are sometimes deceptively impressive.

It is true also that the Nebraska collection affords several bone specimens marked by worn U-shaped grooves of varying and rather large dimensions and of unexplainable origin. These grooves are, however, weathered irregularly, and taken by themselves are meaningless, being in no sense characteristic of true artifacts.

Lastly, there are two, perhaps three, bone fragments which carry decidedly suggestive markings. Two of these specimens are so striking that once more the writer would say that if they had been found in a refuse heap one might conceivably have retained them as showing certain accidental and purposeless indications of human activity. One of these pieces is a rib fragment with some shallow irregular cut-like markings on the inner face. No one can say that these are or are not artificial. They may, however, be nothing but tooth marks. The other piece is a tibia fragment, the sharp natural angle of which carries four slantingly transverse chop-like marks. These markings, though fairly deep, are not sufficiently clean cut to enable any one to say positively that they are artificial; and close to them, moreover, are several other fainter and more irregular markings which are certainly not artificial and which therefore weaken the original possibilities.

There remains the difficult question of accidental fracture. The success of the collector's matching process is really dependent on this feature. And it can not be denied that some of the longitudinal and diagonal breaks exhibited by the Nebraska specimens resemble the breaks to be observed in the animal bones so abundant in our shell-heaps and ruins everywhere and which can with reasonable certainty be attributed to human agency. Some of these fractures in the Nebraska finds are probably old and may have been produced while the bone was green or fresh. But who is prepared to tell us of the finer distinctions—if any—between fresh bone crushed by a carnivor and fresh bone crushed by a man between two stones? Certain other longitudinal fractures characteristic of the Nebraska bones, especially those carrying the split clear through the condyles, are distinctly unhumanlike performances; besides, they seem to me to have been made since the bones were fossilized. Belonging to this latter class are also many clear-cut transverse fractures, which certainly could not have been produced in fresh bone. Finally, the various facets on the fractured pieces often show different degrees of wear and polish, suggesting again that the breaking-up process has been prolonged and at least in part subsequent to fossilization. The more or less uniformly worn or semi-polished condition of certain of the specimens is a matter which may be left for others to explain, but it can scarcely be regarded as the work of man.

The inevitable conclusion is, therefore, in my judgment, that the presence of artifacts in the Snake Creek deposits is not established and can not be established by the collections examined to date.

N. C. Nelson

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THE LIFE HISTORY OF VARANUS NILOTICUS

A paper giving a detailed account of the entire life history of the Nile monitor, *Varanus niloticus,* is being prepared for publication, but a brief description of one of the most interesting chapters of its life will not be out of place at the present time.

The monitor is a large reptile which is fairly common in many parts of Africa, its range extending throughout the continent wherever proper conditions exist. Although it is one of the largest lizards within its range and is not rare even in the more settled districts, comparatively little is known concerning its more intimate activities. The few accounts dealing with the habits of the Nile monitor come from observers who have worked in the tropics rather than in the more temperate regions of South Africa, which probably explains the great difference between the following observations and those previously made by other observers. (For one account of the egg laying, see Roosevelt: "African Game Trails," pp. 411.)

Throughout the section of Natal, South Africa, where these observations were made, there are large numbers of hard clay nests made by one of the most common termites, *Eutermes trinervius*. These nests are cellular in structure, being perforated in all directions by numerous small intersecting passages. The outside of the nest is composed of the same material as that used within, clay, but becomes much harder and offers a good deal of resistance to penetration with a hoe or even a spade.

During the rains the outer covering of the nest becomes soaked with moisture and can be broken into very easily. At this season of the year the monitor digs its way to the center of the nest and lays from a dozen to thirty eggs, about the size of hens' eggs, covered with a tough, leathery integument. As soon as the parent is through laying she returns to her regular habitat, in some cases at least without having made any attempt to cover the eggs. The termites, which are always exceedingly active in a healthy colony, repair the break and in a few hours at most only the presence of a slightly damper area on the surface of the next remains as evidence of what has occurred.

At the end of ten months, which brings the date to the spring of the year, the eggs hatch out, and through their own efforts aided by the softening effect of the excess liquid contained in the old egg "shell," the young make a vertical tunnel and finally emerge from the top of the termite nest. As soon as they have left the nest they make for the nearest stream where they will be found hunting for food and basking on the banks or swimming and diving as readily as do the adults.

RAYMOND B. COWLES

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AT LOS ANGELES

TRINITASIA—A NEW MOLLUSCAN GENUS FROM SOUTH AMERICA

In 1925, I described and figured from the Miocene of Manzanilla, Trinidad, W. I., a shell of very striking form, as *Thyasira sancti-andreæ* (*Bulletin of American Paleontology,* No. 42, p. 166, pl. 30, figs. 2, 3, 1925). The hinge of all the Trinidad specimens was concealed, and they were only provisionally referred to the genus *Thyasira,* on the advice of Dr. W. H. Dall, our greatest conchologist, to whom they were submitted because of their puzzling generic position.

Subsequently I studied a series of shells and molds from northern South America, which graded in size from small individuals to those equalling the Trinidad type and exactly like it in form. Several of the smaller molds showed in reverse traces of strong cardinal hinge teeth. These were certainly not *Thyasira,* which is practically edentulous; and Dr. Dall pronounced them unlike anything he knew. Clearly they represented a new genus, but the larger members of the series did not show their hinge characters, and although they had the same form, one could not be certain that they possessed hinge teeth like the smaller specimens.

Lately, however, I had in hand a full-sized shell, equaling the Trinidad type, and by a happy accident, its very thin and delicate substance was abraded at the beak and marks of about three strong, rather long, cardinal teeth were clearly shown in reverse upon the internal filling. I hope later to figure the hinge structure.

For this interesting Miocene genus of Trinidad and northern South America, I propose the name *Trinitasia,* the genotype being the form described, in the citation above given, as *Thyasira sancti-andreæ* Maury, from the Miocene of Manzanilla, Department of St. Andrews, in southeastern Trinidad.

CARLOTTA J. MAURY

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THE BEHAVIOR OF MALLARD DUCKS

During the recent cold period a very interesting experience was afforded by a flock of about twenty-five Mallard ducks who make their home in a small stream known as Muddy River, in the Fenway section of Boston. With the fall in temperature, and the consequent freezing of the water, it seemed inevitable that the ducks would be driven from their swimming pool. Yet, from watching them, it became apparent that they were not to be driven from their home without a struggle. The ducks began to circle round and round in a radius of about 15 feet with a speed and determination that was amazing. Throughout the entire night, they plied about in their little pool, and though the bitter cold and fast-forming ice, which tried to hem them in, were sufficient to discourage the

most courageous, the ducks were not to be denied, and daybreak found them still in possession. Yet, it was not until the sun was high in the sky that they felt it safe to leave their pool and rest on the edge of the ice.

These ducks serve as the center of attraction for the thousands that daily pass through the Fenway; and as one studies them there seems to be an air of triumph about them as if conscious of having successfully combated the first and most severe thrust of King Winter.

BIRGER R. HEADSTROM

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WANTED—A WORD TO REPLACE "BELIEVE"

FOR some years the writer has avoided the use of the expression "I believe" feeling that it did not adequately express the scientific attitude of mind. Belief is a religious attitude of mind and implies something which the person considers precious and immutable, which he is ready to defend, and for which he is willing to sacrifice even his life. There is nothing in the scientific attitude of mind corresponding to this. Our hypotheses and assumptions and so-called facts are subject to change over night and no one sheds a tear.

Not only does the word "believe" fail to express the scientific attitude of mind, but it is particularly unfortunate to use it because of the effect produced on the non-scientific persons. One reason why the rabid fundamentalists fail to understand the scientist is that they have no adequate conception of our mental attitude in such matters. Their whole attitude of mind is one of belief and they naturally assume that our attitude is similar. They assume that we hold to the theory of evolution as they hold to the (theory of) atonement. Under these circumstances, for us to continue to use the word "believe" simply confirms them in their error.

However, when one attempts to eliminate the word from his vocabulary he finds that it is a very convenient word and one for which it is hard to find a substitute. It is widely used and well understood by the people in a rather loose sense. It is widely used because the corresponding attitude of mind is so universal; it is used in a loose sense because religion has so largely lost its meaning. We who have found the better way still continue to use the old words though we have been warned about putting new wine in old wine skins.

It certainly would be a great improvement if we could find an adequate substitute and even if we can not, it is desirable to eliminate the word from our vocabularies even at the cost of some circumlocutions. If any one can suggest a substitute please speak up.

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THE PRONUNCIATION OF RESEARCH

As pointed out by R. H. Smith, in the issue of January 20, 1928, the average scientist is likely to have certain foibles in pronunciation. Even more annoying to me than the mispronunciation of "data" is the mispronunciation of "research." There was a time when I used to pronounce this word correctly, with the accent on the last syllable, but overwhelming usage seems to place the accent on the first syllable.

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SCIENTIFIC BOOKS

Handbuch der Paläobotanik by MAX HIRMER, with Chapters by Julius Pia and Wilhelm Troll. vol. 1: *Thallophyta, Bryophyta, Pteridophyta.* 624 pp., 817 figs., R. Oldenbourg, Munich and Berlin, 1927.

THIS pretentious work has the usual merits and defects of such an undertaking. It starts off with a rather good 30 page discussion by Pia on methods of preservation. The Thallophyta are also treated by Pia, who probably knows more about the fossil forms than any other living student. This is gotten into 106 pages and is on the whole very well done, although some sections such as that on the Diatoms are too brief to be of much service.

The part on Bryophyta is by Troll and occupies but 9 pages. It is not at all notable and the author does not seem to be familiar with the literature, as many fossil forms are missing. For example no fossil mosses are recorded from North America.

The bulk of the volume, nearly 550 pages, is devoted to the Pteridophyta. As conceived by the author, the term Pteridophyta is quite as broad and comprehensive, and consequently as meaningless as the term Thallophyta. One might forgive the author for not having heard of several more or less valid proposals for segregating the diverse assemblage included under the term Pteridophyta if only his ears were not so keenly attuned to such, to the reviewer, ill advised proposals as the group Protoarticulatineae, suggested recently by a fellow countryman.

The Pteridophyta are segregated in 6 main stocks which unfortunately are given with the *ales* endings universally applied to groups of ordinal rank by botanists. These 6 stocks are Psilophytales, Lycopodiales, Psilotales, Articulatales, Cladoxylales and Filicales, the first four microphyllous and the last

two megaphyllous (wrongly termed macrophyllous). The Psilophytales are thoroughly described and to it the following 5 families are referred: Rhyniaceae, Horneaceae, Pseudosporochnaceae, Psilophytaceae and Asteroxylaceae. One might well question the propriety of making the imperfectly known Pseudosporochus the type of an independent family.

The Lycopodiales are considered to include the following 6 families: Lycopodiaceae, Selaginellaceae, Isoetaceae, Lepidodendraceae, Sigillariaceae and Bothrodendraceae, and aside from certain questions of relative values, are fairly well done.

The Articulatales stock is divided into 5 groups which I suppose have the rank of orders. These with their contained families are: Protoarticulatineae with the families Calamophytaceae and Hyeniaceae, which is considered the most primitive group, although actually based upon 3 highly interesting but imperfectly known and possibly misinterpreted species: Pseudoborniineae with the single family Pseudoborniaceae, also imperfectly known: Sphenophyllineae with the family Sphenophyllaceae: Cheirostrobineae with the family Cheirostrobaceae: and Equisetineae divided into the three families Asterocalamitaceae, Calamitaceae and Equisetaceae.

The fifth main stock, the Cladoxylales, with the single family Cladoxylaceae, seems particularly unfortunate. The group is remarkable enough in its combination of characters and is evidently an isolated one, but no one certainly knows that it is a Pteridophyte. Paul Bertrand, who knows considerably more than the present author about these forms, thinks that they were seed plants. We know something of the habit of the middle Devonian *Cladoxylon scoparium* but its foliage is less deserving of the term megaphyllous than is that of Pseudobornia or Asterocalamites and the supposed association of *Sphenopteris refracta* Goeppert with Voelkelia is by no means established.

The Filicales are treated as Eusporangiatae, Protoleptosporangiatae, Leptosporangiatae, and those of uncertain systematic position. The first includes the Coenopteridineae with six families, and is well done to the extent to which the facts are available; the Ophioglossineae and the Marattiineae. The Protoleptosporangiatae comprise the single family Osmundaceae, and the Leptosporangiatae are divided into 12 families. The volume closes with brief and unimportant chapters on the general morphology of the Filicales and the comparative morphology of the Pteridophytes.

The book is well printed and profusely illustrated, a considerable number being original. It seems to me that the discussion of impressions of Lepidodendron and Sigillaria is well done. The somewhat difficult anatomy of the Coenopteridineae is made rather clear, and there is a full discussion of the diverse forms of Psaronius. The author evidently believes that Thomas has demonstrated that Sagenopteris is the foliage of a seed plant, since it receives no mention in the present volume.

Opinions will naturally differ regarding the success with which Hirmer has performed his self-assigned task. Many omissions could be pointed out, but such are inevitably present in a work of such scope. On the whole I believe that the book will serve a very useful purpose. Its chief defect, in addition to the lack of judgment in the classification adopted which has already been alluded to, is the failure to exhibit any acquaintance with the American literature. For example I find no Mesozoic Lycopodiums recorded from North America, nor any mention of Harder's work on fossil bacteria, or of the important Lepidophyte fructification Cantheliophorus, and I might easily mention a great many other instances. However, no one but a German author seems to have the industry to produce a work of this sort, and no one but a German publisher would undertake to print such a work, so that botanist, paleobotanist and geologist should alike be thankful and give it their blessing.

EDWARD W. BERRY

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CONSTANT RATE ASPIRATOR

IN a study of the factors affecting the rate of respiration in plants,[1] it became apparent that a constant rate of aspiration was one of the most desirable features. Several well-known types of aspirators were tried but in every instance it was found that the desired constancy could not be maintained. A new type of aspirator was developed which combines simplicity, unvarying rate, a wide range of force and portability. The features of this instrument are such that we believe it will prove of value to investigators in all branches of scientific research where a constant rate of aspiration is desired.

The device consists in an arrangement employing the well-known principle of Mariotte's bottle. Two bottles, the size of which depends upon the use to which the operator puts his instrument, are arranged so that one is supported in an inverted position directly over the other as in Figure 1. The inverted bottle is fitted with an intake tube A bent upon itself in the manner illustrated with the open end at x–x′. The reason for bending this tube will be shown later.

[1] Article to appear in a forthcoming issue of *The Botanical Gazette*.

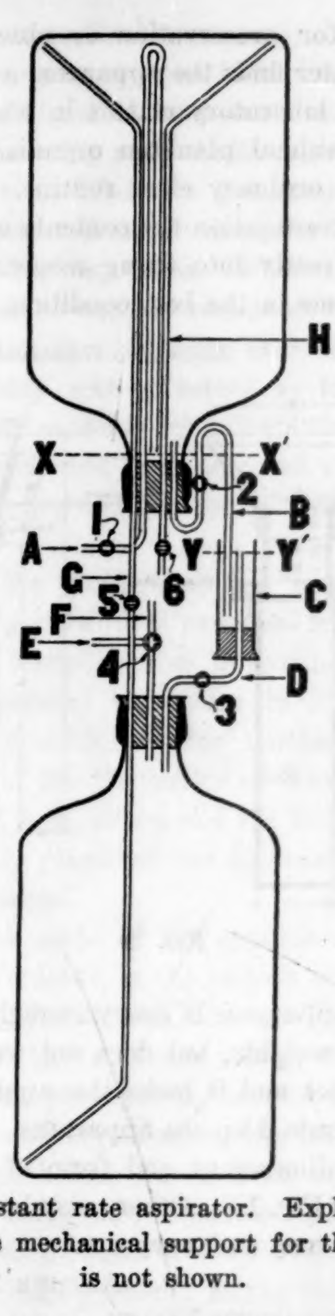

FIG. 1. A constant rate aspirator. Explanation in the text. The mechanical support for the bottles is not shown.

The outlet tube B is bent in the form of an S or a reverse curve with the intake end arranged so that it is well above the open end of A at x–x′ and with the second curve above the level of the intake end. The open end of B extends below the level of the liquid y–y′ in the automatic level device C. When the aspirator is in operation the flow of liquid from the inverted bottle through tube B, automatic level device C and discharge tube D into the lower bottle exerts a negative pressure in the inverted bottle. This negative pressure operates through intake tube A which is attached to the instrument in which a constant rate of aspiration is desired. The rate of flow of gas through intake tube A is determined by the distance between x–x′ and y–y′ minus the resistance offered in the instrument attached to A. When the latter is determined the rate of aspiration is adjusted by controlling the distance between x–x′ and y–y′.

The arrangement in Figure 1 facilitates the rapid refilling of the inverted bottle with the liquid that has been collected in the lower one while the instrument was in operation. This makes possible the reusing of the same liquid. Further, the gas collected in the inverted bottle can thus be analyzed by gasometric methods. Assuming the latter to be the case, air pressure is applied to E through three-way valve 4. Stopcocks 1, 2 and 3 in tubes A, B and D respectively, are closed. Stopcocks 5 and 6 in tubes G and H are opened. The air pressure in the lower bottle returns the liquid through tube G into the inverted bottle, the displaced gas being forced out through tube H. To this tube a gas meter and burette are attached. When all of the gas in the inverted bottle is displaced stopcocks 5 and 6 are closed and the three-way stopcock 4 is opened to F. The instrument is ready for operation when stopcocks 3, 2, and 1 are opened in the order named, tube F serving as an exhaust for the lower bottle.

When this aspirator is used for collecting the gas passing through the instrument attached to A it is essential that the construction of the former precludes the entrance of air. The greatest error from such a source is obtained when the volume of gas changes quickly in the inverted chamber with a lowering temperature. This tends to draw the liquid back through the reverse-curve tube B. To insure the sealing of this tube, constant level device C is made large enough to contain sufficient liquid to compensate volume changes due to temperature variations under the conditions of operation. The construction of the instrument also obviates the possibility of a loss of aspirated gas outward through B. This is obtained by having the level of the outlet of the tube A below the level of the intake of tube B and the second curve of B above its intake end. By this arrangement the aspiration ceases as soon as the level of the liquid in the inverted bottle reaches the intake of tube B. It is desirable not to allow the instrument to operate until the liquid reaches this level, especially if the temperature of the surrounding air is likely to increase.

If tube A is not constructed as shown it is almost impossible to keep the liquid from entering it when refilling the bottle. Should this happen the rate of aspiration is seriously affected. To prevent it, the tube is carried to the top of the bottle before being recurved.

This aspirator has been used successfully in the study of the respiration of plants both under laboratory and field conditions. It is constructed from 40 liter or 20 liter bottles when used in the laboratory and from 10 liter bottles when used in the field. Pyrex tubing with a 4 mm. inside bore is used throughout. A special liquid is employed when gasometric methods are used. It is known to absorb

only slight traces of carbon dioxide and was obtained from Layng and Crum[2] of the chemistry department of the University of Illinois. It consists of a 35 per cent. aqueous solution of zinc sulphate to which 14 grams of concentrated sulphuric acid are added per liter of solution.

CHAS. F. HOTTES
A. L. HAFENRICHTER

A SIMPLIFIED PLANKTON BUCKET

MANY users of the old fashioned naturalist's plankton net who may object to its crudeness or who have employed the commoner expedient of tying a glass bottle into a silk net, will appreciate a simple device which serves the same end much more efficiently. There are a number of elaborate plankton buckets described which serve various purposes but none of these are quite simple or inexpensive enough for the ordinary biological teacher or investigator who purposes only a qualitative collection for classroom demonstration or technical use.

The writer uses, both for class work and for his own investigations, conical fine silk nets of number twelve and twenty grade, and a plankton bucket of his own design. While not especially new in principle, the bucket is simpler and more inexpensive than any he has seen or used before. It may be constructed by almost any one. The bucket is made up of four parts: First, there is an inverted and truncated cone with a fairly long threaded tube attached to the truncated end, secondly, there is another cone exactly like the first one but without the tube, which fits closely over the other of the two cones. A threaded ring which screws on the tube of the first cone is the third part. The first cone is dropped *into* the net and its tube is arranged to project below, outside the net. The second cone is then fitted to the first from the *outside* of the net with the silk between the two. The two cones are now clamped together and held tightly by the threaded ring; they lock the device to the apex of the net. The fourth part of the apparatus is the bucket, a simple cylinder closed at one end and threaded at the other to fit the tube of the inner of the two cones. The cylinder is of uniform diameter and may or may not have a flange at its threaded end to give weight to the apparatus. The cylinder is screwed to the tube and the bucket is ready for use at once. All parts are constructed of brass.

The net arranged as above may be used exactly as other rigs, but one needs only to unscrew the cylinder to release the catch, and pour the collected plankton into a bottle for preservation or observation while alive. The writer finds the apparatus a very valuable adjunct to his laboratory classes in which a number of plant and animal plankton organisms lend much interest to the ordinary class routine. In collecting material for investigation the contents of the cylinder may be put directly into fixing reagents in the field and carried home in the best condition.

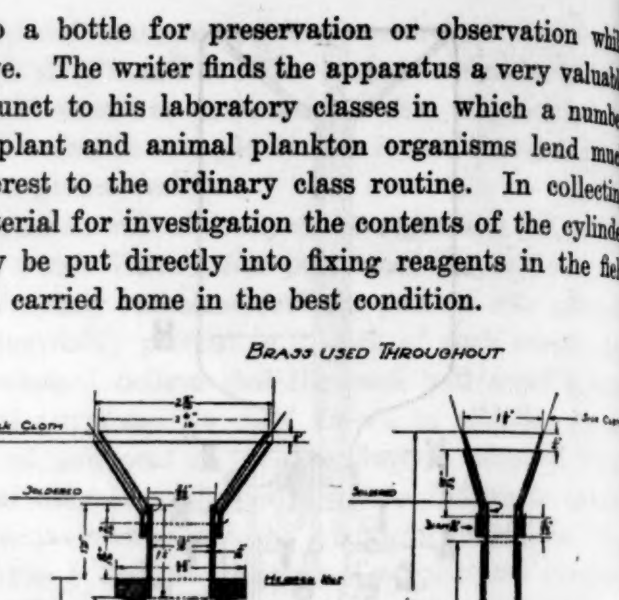

FIG. 1

The whole apparatus is heavy enough to sink easily without extra weights, but does not weigh enough to tear the wet net and it lacks the cumbersomeness of the more elaborate deep-sea apparatus. The diagrams illustrate the dimensions and form of two rigs used by the writer (Fig. 1). Others may be used of course to fit different nets and purposes.

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SPECIAL ARTICLES

OBSERVATIONS ON HEATING HAY IN THE FLOODED REGIONS OF NORTHERN VERMONT

MANY interesting reports of the devastations wrought by the recent floods in Vermont and Massachusetts have been written. Little mention has been made, however, of the effect of the floods upon the tons of feeding stuffs stored on the farms for winter use. The agricultural pursuits of the farmers in the valleys of the Vermont rivers have been confined largely to dairying, most of the flat valley land being used for hay production. In New England the length and severity of the winter season make it imperative that the farmer be well supplied with hay for his stock.

[2]Layng, T. E., and S. A. Crum, "On Examination of Methods of Gas Analysis." Unpublished paper, University of Illinois.

In order to store the hay properly, large barns with deep bays or open sections extending usually from the ground to the roof have been constructed. The recent floods, coming early in November, found practically every barn filled with good meadow hay. The flood waters entered many barns, covering as much as 17 feet of the hay piles. When the flood waters receded, masses of wet hay remained, in which intense heat production soon became evident. This "spontaneous" heating was so severe as to endanger the barns and their contents with fire. One fire attributable to this cause had been reported, and the farmers were deeply concerned for the safety of their buildings.

Studies of the problem of the "spontaneous" heat production in agricultural products have been undertaken in the United States Department of Agriculture.[1] The unusual conditions in Vermont offered exceptional opportunities for further investigation. The facilities of the University of Vermont, including the College of Agriculture and the Extension Service, were generously placed at our disposal and are gratefully acknowledged.

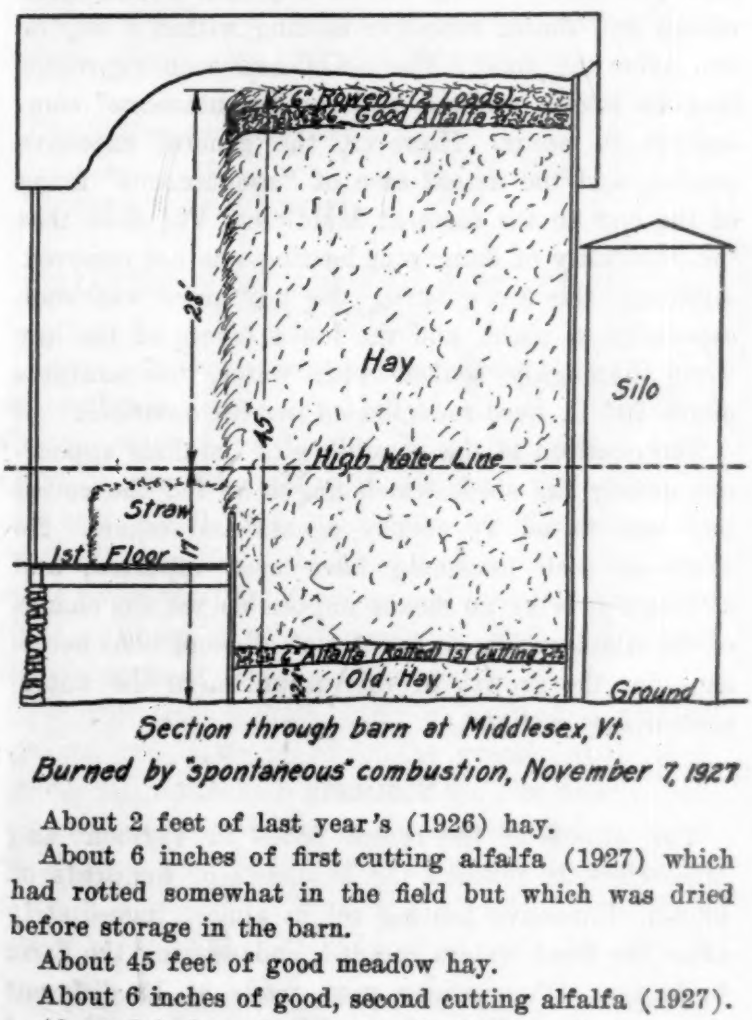
Studies were made of the conditions on 13 farms in Northern Vermont, in the valleys of the Winooski, Lamoille and Mississquoi Rivers. The wetting and heating of the hay at these places were said to be typical of those throughout the entire flooded area. In many cases actively steaming hay had been removed from the barns before our arrival, and many other lots were then being thrown out as rapidly as possible with the limited amount of help available. A brief résumé of the data gathered at the thirteen farms is given below. Eight of the farms are in the valley of the Winooski River, and five are in the valleys of the Lamoille and Mississquoi Rivers.

The floors supporting the hay in a few of the barns consisted only of boards resting directly upon the ground. In the majority of the barns visited, however, the hay was piled above the first-floor level, and the stock was housed in basement stalls beneath. The rising waters entirely covered the stalls and immersed as much as eight feet of the hay piles.

"Spontaneous" heat production had begun in the bottom wet layers of the hay, and the hot gases rising through the stacks led to the production of strong draughts or "flues." The moisture thus carried upward condensed in the cooler parts of the hay or in the air above, wetting the hay in the immediate area. So many of these draughts had existed in some piles as to soak the hay thoroughly. Similar draughts were observed in all heating piles of hay. Temperatures in typical "flues" ranged from 47° to 74° C.

When we arrived the period of most marked heating had passed, and the temperatures were then on the decline. Many piles of hay had shown such marked steaming as to prompt the farmers to remove them immediately to the open. A large number of the men students of the University of Vermont, at Burlington, cheerfully gave their full time and energies to the pitching of the hot hay out of the barns. While forking over the hot material, only one farmer had observed any evidence of charring.

One clear-cut case of "spontaneous" ignition of heating hay occurred on a farm near Middlesex, Vermont. This farm is in a narrow portion of the valley of the Winooski River where the flood waters rose exceptionally high. The barn held about 50 tons of meadow hay and a little alfalfa. The hay had been kept in a bay in the rear of the barn and rested upon boards laid flat on the ground. The contents of the bay at the time of the flood, as shown in the accompanying diagram, considered from the bottom to the top consisted of:



Section through barn at Middlesex, Vt.
Burned by "spontaneous" combustion, November 7, 1927

About 2 feet of last year's (1926) hay.

About 6 inches of first cutting alfalfa (1927) which had rotted somewhat in the field but which was dried before storage in the barn.

About 45 feet of good meadow hay.

About 6 inches of good, second cutting alfalfa (1927).

About 6 inches of rowen on the top.

There was also a small pile of old dry straw on the barn floor.

The flood waters covered 17 feet of the pile of hay and most of the straw. No heating of the hay had been noticed before the flood, but considerable steam-

[1] James, L. H. "Microbial Thermogenesis." I. SCIENCE, LXV, May 20, 1927, 504–6; II. *Jour. Bact.*, XV, February, 1928, 117–41.

ing was in evidence 24 hours after the waters had receded. The crest of the flood occurred early on Friday morning, November 4, and the barn burned between 4:00 and 5:00 P. M. on Monday, November 7, or about two days after the flood waters receded. On Sunday much heating had been noticed and on Monday a distinctly charred odor was noticed before the fire started. The barn burned to the ground and a silo, close to it, fell over and also was destroyed. It is interesting to note that owing to the contour of the land, the barn and hay stood in about 3 feet of water when the fire broke out.

A number of veteran farmers living close to the Canadian border were visited. Several claimed to have had marked success in stopping "spontaneous" heating of hay by the application of large quantities of salt.

It is unfortunate from the standpoint of the accumulation of scientific data that observations of the heating hay piles were not begun for about six days after the flood waters had receded. Discussions with county agents, agricultural men and farmers revealed that practically every lot of hay which had been wetted had shown excessive heating within a day or two after the flood. The belief had been expressed that the season was too cold for "spontaneous" combustion to occur. However, the general excessive heating and the actual case of "spontaneous" firing of the hay on the farm at Middlesex, Vt., show that the possibility of dangerous heating was not removed. Although the air entering the hay piles was cool, especially at night, and the lower layers of the hay were thoroughly soaked with water, temperatures above 70° C. were recorded on several occasions.

The question of the possibility of botulism appearing among the stock which might be fed the rotted hay was raised by county agents and others. No cases of such poisoning have been reported, and although it is by no means impossible yet the chance of the simultaneous occurrence of all conditions necessary for the growth of this organism in the water-soaked hay is slight.

Summary

The waters of the recent floods in Vermont and Massachusetts reached the haymows of hundreds of barns. Excessive heating set in almost immediately after the flood waters receded, endangering the farm buildings. Observations were made at 13 different farms in the valleys of the Winooski, Lamoille and Missisquoi Rivers. These observations are summarized in the following statements:

1. From half a foot to seventeen feet of the piles were under water.
2. In every pile of wet hay observed some "heating" had taken place, frequently to the point of being considered dangerous.
3. Heat was generated in the bottom layers of the piles and, escaping up through the hay, led to the production of draughts of hot gases or "flues" rising to the surface.
4. The large quantity of moisture carried with the hot gases from the lower layers was condensed on the upper, cooler hay, or in the air above. Many hay piles had been soaked throughout by the falling condensed moisture.
5. While the hot hay was being removed from the barns only one farmer had observed any charred materials.
6. The maximum temperature found (besides one case of fire) was 74° C., though temperatures above 70° were recorded in other places.
7. The most marked evidence of excessive heating was observed (by the farmers) on the second and third days after the recession of the flood waters.
8. One authentic case of "spontaneous" combustion of hay caused by the flood was reported. The outstanding features were:

a. The lower two feet of the pile consisted of old hay from the preceding season (1926).

b. Covering this lower 2-foot section of old hay was a 6-inch layer of first cutting alfalfa.

c. Two feet beneath the top surface of the 42-foot pile was another 6-inch layer of alfalfa (second cutting).

d. This hay pile which fired "spontaneously" was the only one containing even a small quantity of alfalfa.

The urgent need for extensive research upon the problem of the "spontaneous" heating of farm products was emphasized by the lack of scientific knowledge with which to meet the situation.

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THE RELATION OF BORON TO THE GROWTH OF THE TOMATO PLANT

It is surprising to note the prevalence of the old idea that the number of elements essential for normal plant growth is limited to ten. To this list of "preferred" elements, to use the expression of Sommer and Lipman,[1] have been added manganese, zinc, boron and without a doubt several others will be annexed as methods and technic become more and more refined. There is little doubt that in the past, failure to obtain good plant growth in numerous water-culture experi-

[1] Sommer, A. L., and Lipman, C. B., "Evidence on the Indispensable Nature of Zinc and Boron for Higher Green Plants," Plant Physiology *1*: 231–249. 1926.

ents was due to a deficiency of some of the above-entioned elements so long overlooked. An illustraon with regard to boron will serve as an example.

In a series of experiments dealing with certain otassium relations of the tomato plant, it was found npossible to obtain anything that even approximated ormal growth in water cultures without the addition f a small quantity of boron. This circumstance was specially interesting since no attempt had been made o purify the ordinary C. P. chemicals used in the olutions. These observations led to a series of experiments dealing with the relation of boron to the rowth of the tomato plant. It is believed that some f the results obtained are interesting enough to warant this brief preliminary paper. Both the appearnce of the plants as well as actual measurements and nalyses clearly showed boron to be absolutely esential.

Most of these experiments were carried out in the ivision of plant nutrition at the University of Caliornia, with the variety Santa Clara Canner. Some of he experiments have been repeated at the University f Maryland with this same variety and with Marglobe. Boron was supplied as boric acid in a conentration of 0.5 p. p. m. Plants grown in nutrient olution containing this concentration of boron grew ormally and produced blossoms. Plants grown in he boron deficient solutions ceased to grow at the end f three or four weeks. In the Maryland experiments he first signs of injury were noticed after nine days. One of the early visible symptoms of boron deficiency is the blackened appearance at the growing point of the stem. New leaves and branches often start growing just below this dead portion and give to the plant a short bushy appearance. Often the leaves grow in length, but not in width. Chemical analysis in the case of the Berkeley experiments showed approximately twice as much total sugars in the leaves of the boron deficient plants as in those from normal plants grown in a similar manner, but in solutions containing boron. The leaves from the boron deficient plants also contain more starch than those from the normal plants. On the other hand, the quantity of total sugars in the stems of the boron deficient plants is only about two thirds of that in the stems of normal plants. The leaves of the boron deficient plants at College Park developed, after 13 days, a distinct purple color, probably anthocyan, which is frequently associated with an excess sugar accumulation. Another very striking characteristic of the boron deficient plants is the extreme brittleness of the leaf petioles. This brittleness is not that characteristic of turgid stems, which break with more or less snap, but it is one that may best be described as similar to the breaking of a piece of cheese.

Both the chemical analysis and later observations on an entirely different variety indicate a failure on the part of the boron deficient plants to remove sugar from their leaves. This seems to be related to a breaking down of the conducting tissues. Microscopic examinations of the petioles and stems made by Professor J. H. Priestley on a few of our plants seem to bear out this view. In the boron deficient plants the phloem was broken down and apparently gave a much more acid reaction than the corresponding regions of the normal plants.

These general conclusions are in agreement with the anatomical studies of Warington[2] on *Vicia Faba* (broad bean) grown in boron deficient solutions. She states, "The vascular bundles in particular are affected, the xylem often appearing unusually remote from the phloem or even broken up into small groups of elements . . . an unusual development of the cambium is chiefly responsible for this abnormal appearance." The phloem is described as becoming compressed or displaced and the xylem itself may degenerate. Frequently the lumen of the tracheides become completely blocked. These conditions of the broad bean seem to be very similar to those occurring in the tomato when grown in boron deficient solutions.

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TRIASSIC VERTEBRATE FOSSILS FROM WYOMING

DURING the past summer the writers, with the able and enthusiastic assistance of Mr. N. H. Brown and his son, Newton, of Lander, Wyoming, added materially to the University of Missouri collections of vertebrate fossils from the Triassic of Wyoming. All the fossils came from the Popo Agie beds of the Chugwater formation, but from several scattered localities. Chief of these are the quarries on Bull Lake Creek and Sage Creek, Fremont County.

The collections include both reptilian and amphibian remains, the latter in much the greater abundance. Among the amphibian materials are two nearly perfect skulls similar in many respects to the specimen from Texas described by Case as *Buttneria perfecta*.[1] There is in addition a considerable part of four other skulls; at least two distinct types of clavicular girdles,

[2] Warington, Katherine, "The Changes induced in the Anatomical Structure of *Vicia Faba* by the Absence of Boron from the Nutrient Solution," *Ann. Bot. 40*: 27–42. 1926.

[1] E. C. Case, "New Reptiles and Stegocephalians from the Upper Triassic of western Texas," Carnegie Inst. Wash. Publication No. 321, pp. 13–25, 1922.

each represented by several specimens, some of which appear to be complete; several mandibles, and numerous limb bones and vertebrae. Lower jaws, limb bones and clavicles were found rather closely associated with two of the skulls.

The reptilian remains consist of several imperfect phytosaur skulls, isolated limb bones, vertebrae of several types, teeth not yet identified, and several footprints of such a nature that the stride can be determined. It is thought that the phytosaur material will clear up some of the doubtful points in two little known genera, *Palaeorhinus* Williston and *Angistorhinus* Mehl. In two of the quarries a large amount of bone remains to be excavated.

The study of this new material has progressed little beyond the point of raising again the entire question of Triassic correlations. It appears to the present writers, who have been in intimate contact with Triassic problems in one capacity or another for many years, that in correlations much stress has been placed on paleontological evidence of a very unsatisfactory nature, particularly in the use of the vertebrates. Attempts have been made to designate various horizons as Lower, Middle or Upper Triassic on the basis of "primitive" or "advanced" forms. One of the more recent of such attempts is that by Huene.[2] Here, as in an earlier and more elaborate correlation table,[3] a rather meager list of "primitive" forms, genera for the most part inadequately known and of very limited geographic range, serves to place much of the bone bearing western Triassic as equivalent to the European Muschelkalk or even lower.

In time these assumptions may prove to be well founded, but at present they seem little better than guesses without particular merit. The writers place little confidence in such long range correlations based on present vertebrate evidence and they are not entirely enthusiastic over future possibilities, the abundance of recent additions to the collections notwithstanding. In the first place, while there seems to be no great difficulty in determining primitive and advanced forms, except that the individual is often a peculiar combination of the old and the new, there is no assurance that one can differentiate between earlier and later forms by this means. On the other hand, there is evidence that during Triassic times primitive and highly specialized forms were often contemporaneous. *Acompsosaurus* Mehl, listed by Huene with the Middle Triassic forms from New Mexico and Arizona, was based on a pelvic girdle with peculiarly down-turned pubes, a character scarcely to be designated as primitive. In this particular, *Acompsosaurus* resembles Huene's phytosaur genus *Angistorhinopsis* except that in the former the down-turning is much more pronounced. *Angistorhinopsis* is found only in the uppermost Keuper.

The insecure foundations of present Triassic correlation are further evidenced by the difficulties encountered in placing the members of a single formation in a limited area. The Chugwater formation of central and southern Wyoming illustrates the point. The Jelm of southern Wyoming is commonly correlated with the Popo Agie beds of central Wyoming, apparently because both members contain vertebrate remains and because of the assumption that both are of the Upper Chugwater. So far as the writers know, dependable fossil evidence has not been found in the Jelm. During June of the past year Branson examined the Jelm with the view of obtaining identifiable fossils, but found only scraps. The Popo Agie beds are the source of the recognizable Triassic vertebrates throughout central Wyoming. As recently emphasized by Branson,[4] these beds do not form the upper part of the Chugwater of this region, but are near the middle. The Popo Agie and the Jelm are both near-shore or actual land phases of the Chugwater. The conditions recorded by these members undoubtedly existed over limited areas from time to time throughout the Chugwater, and are not evidence of contemporaneity.

The point the writers wish to emphasize is that vertebrate fossil evidence must be used with the greatest caution in Triassic correlations and that present vertebrate summaries do not lend themselves to such usage. It is the intention of the writers to publish a series of papers describing the Triassic vertebrate remains in the University of Missouri collections. At present they are preparing descriptions and summaries of the amphibians from the Triassic of Wyoming. Later, amphibian materials from New Mexico and Arizona will be included. It is hoped to present in a similar way the Triassic reptiles. As a start in this direction Mehl is preparing descriptions of the new or little known phytosaurs represented in the collections.

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M. G. Mehl

The University of Missouri

[2] F. R. von Huene, "Notes on the Age of the Continental Triassic Beds in North America with remarks on some Fossil Vertebrates," *Proc.* U. S. Nat. Mus., Vol. LXIX, pp. 1–10.

[3] "Neue Beiträge zur Kenntnis der Parasuchier," *Jahrbuch der Preussischen Geologischen Landesanstalt*, Band XLII, Heft 1, pp. 59–160, 1921.

[4] E. B. Branson, "Triassic-Jurassic 'Red Beds' of the Rocky Mountain Region," *Jour. Geol.*, Vol. XXXV, pp. 607–630, 1927.

SCIENCE NEWS

Science Service, Washington, D. C.

DARWINISM

THE frequent statement of critics of the evolutionary hypothesis, that Darwinism is dead and that scientists are rejecting evolution wholesale, is sharply challenged by Professor T. H. Morgan, of Columbia University, one of the foremost of living biologists.

Writing in the April issue of the *Yale Review*, Professor Morgan states that this misconception apparently has arisen out of a confusion over the several distinct meanings that Darwinism has come to have. In its broad sense, as meaning evolution in general, the doctrine is becoming more firmly entrenched every year.

In its more strict sense, as meaning evolution caused by natural selection at work on small, fluctuating variations in a given plant or animal stock, Darwinism has come in for more or less criticism from scientists, though even this does not mean that it has been totally rejected. It merely means that scientists have recognized certain difficulties that were not clearly seen in Darwin's own day. Professor Morgan calls attention to one of these, which makes it difficult to derive one species from another. He says:

"If any particular character, such as size or color, is measured in a large number of individuals of a race or species, it is found to vary. Some of the individuals will be smaller or fainter in color; others, larger or darker; but the great majority will be average or middle class. If the smaller individuals are destroyed and the larger ones become the parents of the next generation, the resulting population will again show a wide range of variability, but the middle class will be a little taller than was that class in the parental population. Suppose again in the next generation, the smaller individuals are destroyed and only the larger ones left to breed. The same result follows, and the average may again be somewhat larger. Experience has shown, in fact, that the average population may in most cases be changed by eliminating consistently certain kinds of individuals through a few generations. But then the process slows down rather quickly and soon comes to an end. Further selection fails to produce further change. The upshot has been not to produce a new race in which all the individuals are taller than the tallest of the original race, but only a race in which the average individual has become taller. The tallest may be no taller than before. This fact was not known to Darwin, or at least, if vaguely known, it was not given due weight."

Professor Morgan is inclined to believe that the force which gets new species past the limits of the old is to be sought in the phenomenon of mutation, in which sudden and relatively large changes occur. When such changes are hereditary, as they frequently are, they provide material on which the process of natural selection can work in the manner postulated by Darwin. Students of evolution have concentrated too much attention on the "survival value" of visible body structures, such as claws and teeth, at the expense of less tangible but perhaps more important things, such as inherited ability to withstand cold or drought, or to run or fly fast, which are of obvious importance in the struggle for survival.

VITAMIN F

THE day when we will live on synthetic concentrated pills of food is yet far distant. Yet the latest attempts to raise laboratory animals on an artificially devised diet of pure foods have led to the discovery of the new vitamin F, recently announced by Dr. Herbert M. Evans, of the University of California.

When a diet of purified food elements consisting of casein and recrystallized cane sugar, certain necessary salts and the five recognized vitamins, A, B, C, D and E were fed to rats in the laboratories of the department of anatomy, the animals failed to reach more than half size. Theoretically this diet contained all the elements necessary for the health and happiness of rats, but actually something else was necessary. Growth stopped altogether and the animals remained sexually immature. Natural food had to be resorted to, to supplement what might be called a chemically pure menu in order to reawaken their growth and convert them into healthy adult animals.

"Among the natural foods, lettuce and liver were the most potent," declared Dr. Evans, "and they, therefore, almost certainly contain a new sixth member of the vitamins, to which designation F will be given."

Lettuce when heated and dried failed to give the good results of the fresh product, the investigation showed.

Dr. Evans has to his credit also the discovery of vitamin E, at one time known as vitamin X, a lack of which brings about sterility. Oil from the germ of the wheat grain is thus far the most potent source of this necessary food factor.

DISEASES OF THE CALIFORNIA FIG CROP

WARFARE against a plant disease that threatens California's huge fig industry is being waged at Fresno by a unique scheme of campaign. It all centers around keeping a certain small insect, a little wasp no bigger than a gnat, aseptically clean. If the fig-wasp can be kept clean the figs will be saved.

This tiny wasp, called Blastophaga by scientists, looms so large in the fig business because she is the only creature than can pollinate the Smyrna fig, which is the most valuable variety raised in California. The Smyrna fig, being exclusively female, produces no pollen itself, and the wasp is depended on to transfer pollen to it from an exclusively male fig variety, known as the "caprifig," which produces inedible fruits, but plenty of good pollen.

The Blastophaga wasps breed only in the fruits of the caprifig, and emerge from them as adult insects covered with pollen. Fig growers fasten caprifig branches in their

NEW SCIENTIFIC BOOKS

The McGraw-Hill Book Company, New York

GUIDE TO THE CONSTELLATIONS. Samuel G. and William H. Barton. pp. x + 74. Illustrated. $2.50.

Devoted exclusively to naked-eye, observational astronomy and written for beginners and as a supplement to the gular text-books. Because of the many large charts inuded, the book will also be helpful as a source of referce.

The Macmillan Company, New York

LLEGE TEXT-BOOK OF HYGIENE. Dean F. Smiley and Adrian G. Gould. pp. xiv + 333. $2.00.

Based throughout on those facts of hygiene which have en demonstrated as valuable by modern scientific rearch. The plan of the book has been developed gradually ring the past seven years in the courses in personal and mmunity hygiene for Cornell University students.

University Press Association, Honolulu

HE MATRIX OF THE MIND. Frederic W. Jones and Stanley D. Porteus. 457 pp.

In writing this book the authors have had a very definite m—the blending of the subject-matter and viewpoints of o sciences which have the same physical structures as a sis, namely, psychology and neurology.

Oxford University Press, London

LEMENTARY BUILDING SCIENCE. Alfred Everett. 159 pp.

No new science is implied in this title, but rather the application of physics and chemistry to building and building aterials and related problems. Some of the chapters are: easuring and Weighing; Transference of Heat; Hard and oft Water; the Barometer, Pumps and Siphons; Building aterials.

Smyrna trees, and the wasps, attempting to enter the immature Smyrna figs, accomplish their fertilization. The resulting seeds in the Smyrna figs give them their special value and the medical properties which are claimed for them.

Thus for many years the little fig-wasp has been a vital factor in the prosperity of California fig growers. Now she threatens to be the agent of their ruin, because a serious outbreak of a brown-rot disease has occurred among the figs, and the fig-wasp has been shown to be the unwitting carrier of its germs. Every fig it pollinates it also infects with the virus of destruction, for the pollen-providing caprifigs are infected, and the wasp carries off the infection when it carries off the pollen.

To break this vicious circle a drastic and elaborate clean-up campaign has been necessary. Instead of letting the fig-wasp breed and over-winter in its natural way, the stock of insects that are to fertilize this year's crop has been concentrated in a newly built "insectary" near Fresno, and fig-growers have been required to ship every single caprifig fruit there. Millions of insects and tons of caprifigs, have been assembled.

The wasps are brought out of their over-wintering condition in special incubators, and are allowed access to the caprifig pollen only after the fruits containing it have been carefully sterilized to kill the brown-rot germs. Then the wasps are induced to enter special mailing tubes which are sent to the fig growers. Released in the orchards, the little pollen-carrying insects proceed to the Smyrna fig flowers and complete their fertilization.

State officers inspect all orchards to see that no caprifig fruits, containing possible infection, are left on the trees. If the clean-up campaign can be made 100 per cent. complete for a few years, it is believed that the disease will be completely stamped out.

LIVER FOR FISH FARMS

THE high cost of liver, due to recent medical discoveries of its high value in the human diet, puts the directors of fish hatcheries up against a new and stiff problem. Young fish like liver; it is probably better for them than any other kind of meat they can get. Hatcheries are increasing their facilities so that they can handle billions of fry and fingerlings instead of mere millions, and there is a tendency to hold the little fish until they are from four to ten inches long instead of turning them out into a rough and predatory world while they are still of mere minnow size, as formerly.

All this means a vastly increased demand for fish fodder, and fish men are looking the market over with considerable care and anxiety.

To ascertain the quantity, kinds and costs of fish foods used in the United States, the U. S. Bureau of Fisheries recently made a canvass covering about 200 private and state hatcheries in addition to the 44 federal hatcheries. The results of this survey indicate a consumption of about 3,500 tons of fish food, valued at $275,000 per annum.

The principal fish foods now used are sheep plucks, horse meat and other fresh meat, beef liver, beef lungs, pig liver, cereal products and fish, arranged in order of their importance.

Beef liver is generally recognized as one of the best fish foods, its use being limited by its high cost. Feeding tests conducted by the Bureau of Fisheries at the Holden, Vermont, station during 1927, reveal that much better results can be obtained from feeding brook trout beef heart for the first four or five weeks and then changing to a mixture of equal parts beef heart and beef liver than by using either alone. An unusually low mortality resulted from the use of this combination. Feeding tests in which clam meal was used gave very promising results.

THE STUDY OF BIRD MIGRATION

BIRD enthusiasts who want to help solve the problems of bird migration will have plenty of employment trying to get returns on the 270,000 birds that have been banded under the auspices of the U. S. Biological Survey. Returns on banded birds, according to Frederick C. Lincoln, in charge of this activity of the survey, now amount to 10,338 cases. Knowledge of the movements of the bird after its initial banding, gained from these return reports, enables ornithologists to get precise information concerning bird migration.

Ducks furnish the most returns, undoubtedly due to the fact that many banded waterfowl are taken by the millions of hunters in the field during the hunting season.

Prominent among the bird problems of economic interest which banding may be expected to solve, Mr. Lincoln pointed out, is the control of red-winged blackbirds that do much damage to the rice crop of the South and of California in late summer and early fall. Poison bait has proved ineffective in the rice fields, so that control measures must be undertaken at other times and other places.

"The question, therefore," Mr. Lincoln explained, "that confronts the economic ornithologist, which may be at least partially answered by banding red-winged blackbirds, is whether the individuals in the flocks that are so destructive in fall are the same as those that may be readily destroyed elsewhere at other seasons."

Observations made at one banding station have shown, he added, that the "budding" of fruit trees by purple finches has had no bad effects on their bearing, but might have been responsible for an actual increase in the yield of fruit.

THE ST. FRANCIS DAM

A SHORTAGE of water and electricity in the regions around Los Angeles, California, will be the chief effects of the breaking of the St. Francis dam. Since the dam drained into the ocean through a valley entirely separate from that in which Los Angeles was located, the city itself was in no danger from flood.

The dam was part of the Los Angeles municipal system and, while it was not used for hydroelectric power, one of the two largest of the city-owned power plants was in the San Francisquito canyon below it and was put out of business by the flood. As only a part of the city's power is obtained from these plants, a large amount being purchased from private companies, the loss in power could be taken care of.

About 1,655,000,000 cubic feet of water was impounded in the reservoir behind the St. Francis dam, before the

heavy rains burst it and emptied the water down the valley, to the Santa Clara River, and thence to the Pacific near the city of Ventura. Though not the country's largest dam, it was in the front rank as far as size was concerned. It was 205 feet high, as compared with 280 feet for the Roosevelt dam, in Arizona. The largest is the Exchequer dam, in northern California, which is 330 feet high. The St. Francis dam was 650 feet long, and 169 feet thick at the base.

PREHISTORIC SKULLS FROM FLORIDA

PREHISTORIC inhabitants of southern Florida may not have known the fountain of youth that the Spaniards sought in Florida, but they were an extraordinarily healthy lot, judging by bones which have been taken from a burial mound near Ft. Myers. Only one diseased bone was found in the mound, according to Henry B. Collins, Jr., anthropologist of the U. S. National Museum, who excavated at the site.

Mr. Collins has just returned to Washington with eighty skulls from this mound. The skulls are pronounced those of the famous Calusa Indians, the tribe which first greeted Ponce de Leon and routed the youth-seeking Spaniards with a shower of arrows. The Calusa had the reputation of being cannibals and fierce warriors, but they were among the first Indians to be wiped out by the white man, and by the time of the American Revolution they were practically extinct.

"Remains of these extinct Indians have been extremely rare, and very little has been known about them," said Mr. Collins, in describing his expedition. "The skulls show that the Calusa were not particularly large or powerfully built people, as were tribes of northern Florida."

A strange discovery from the mound was that only half a dozen of the eighty burials were children. Whether this means that these Indians were more successful than most tribes in raising their children, or whether babies who did not survive were disposed of in some other way, can not be determined.

No Indian possessions were found in the burial mound, with the exception of some fragments of pottery. These broken pieces of pots and jars had been stuck in the ground all around the heads of most of the Indians, probably with some magic rite.

The burial mound was outlined by a border of conch shells over two feet wide, the white shells making a sharp contrast against the black muck of the mangrove swamp. Further excavations were made in a number of large shell heaps, some of them 30 feet high, but these kitchen dumps of the Calusa revealed no traces of cannibalism or other unusual practices.

ITEMS

IN an endeavor to check the mosaic disease of sugarcane, which is one of the most destructive of tropical plant diseases, the State of Rio de Janeiro, Brazil, has offered a prize of approximately $1,200 to any scientist who, before the end of the current year, will ascertain its cause and determine an effective method for combatting it.

SALT mines that were operated on an extensive scale, with very "modern" shafts, tunnels and drifts, more than 500 years before Christ, have lately been explored near Hallstadt, Austria, by Dr. Adolph Mahr, of the Vienna State Museum. In addition to knowledge of the mining methods of these prehistoric men of the early Iron Age, the exploration yielded also numerous articles of leather and wood, well preserved against decay during the ages by their burial in salt. These finds included pick handles, torches, wedges, mine timbers, felt caps, shoes of wood, leather and felt, leather hand-protectors, and many other articles. The exploration was backed by two Americans, Professor F. W. Bade, of the University of California, and Major Gotshall.

BRITISH scientists have been at work to make palatable the famous roast beef of England that has to come in these days from Australia or South America. The freezing process necessary to carry the meat on its long journey dries up all the natural juices. It has been found, however, at the Low Temperature Research Station at Cambridge that when beef is frozen and thawed very slowly, practically no fluid is lost. In one experiment the time consumed in freezing and thawing took nearly 80 days at the end of which the meat was hardly distinguishable from fresh. If this method can be applied in industry, it may be of considerable commercial importance.

A NEW combination of chaulmoogra oil with benzocaine has enabled several lepers at the National Leprosarium, at Carville, Louisiana, to receive the benefits of the curative drug with a minimum of pain. The discomfort which accompanies the administration of chaulmoogra oil is a problem with which specialists in leprosy have struggled for years. Consequently the success which has attended the use of benzocaine-chaulmoogra oil by Dr. Frederick A. Johansen, of the U. S. Public Health Service, on 24 lepers at the leprosarium may mark an important step forward in the treatment of this ancient disease. This preparation has the advantage of not causing pain, and of absorbing readily, thereby giving the patient a uniform amount of chaulmoogra oil over a definite period of time. Since the treatment was started 36 patients have been added, making a total of 60 who are taking the injections semi-weekly as routine treatment.

MARCH has the highest pneumonia death rate of any month in the year. Frequently more than one seventh of the annual pneumonia mortality occurs in this single month, according to statistics of the Metropolitan Life Insurance Company. The large number of pneumonia deaths have not been attributable to any single cause, such as latitude, altitude, extreme cold or heat, high or low humidity, age distribution of the population or occupation. A combination of factors is felt to be responsible for the high mortality of this disease. A cold climate where the average humidity is not high appears to operate in favor of low mortality, a condition illustrated by the very low pneumonia rate for the western provinces of Canada. Oregon and Washington, also, have fewer pneumonia deaths than the average while Pennsylvania, New York and New Jersey in approximately the same latitude consistently register some of the highest rates.